DOCUMENT RESUME

ED 454 758 HE 034 115

AUTHOR	Chambers, Jack A., Ed.
TITLE	Selected Papers from the International Conference on College Teaching and Learning (12th, Jacksonville, Florida, April 2001).
INSTITUTION	Florida Community Coll., Jacksonville. Center for the Advancement of Teaching and Learning
PUB DATE	2001-04-00
NOTE	217p.; For the papers from the 11th conference, see ED 440 975.
PUB TYPE	Collected Works - General (020)
EDRS PRICE	EDRS Price MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS	College Faculty; *College Students; *Computer Uses in Education; *Distance Education; *Educational Technology; *Higher Education; *Online Systems; Technological Advancement

ABSTRACT

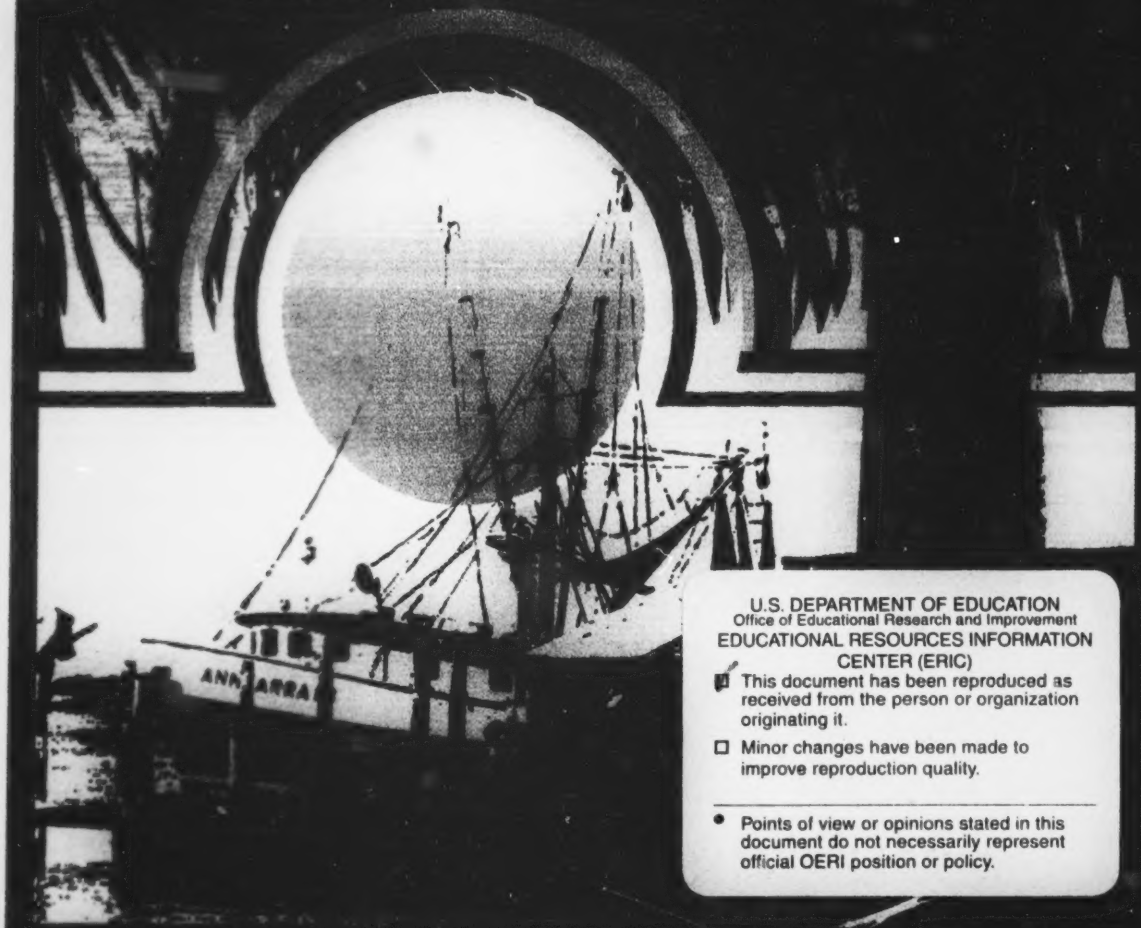
This collection contains the 20 best papers from a conference at which nearly 300 faculty members presented papers. Those that were selected by juried review include: (1) "Where Have You Been? A Case Study of Successful Implementation of Undergraduate Online Learning Communities" (John Barnett); (2) "A Strange Sense of Disquietude: Understanding Resistance to Learning Technologies" (Sian Bayne and Ray Land); (3) "Designing Learning Experiences for Enabling Collaborative Discovery Online" (A. Faye Borthick); (4) "Humanizing the Interactive Video Conference Experience for Aboriginal Students" (W. Dean Care); (5) "Using Immersive Virtual Environments To Humanize the Learning Experience" (Karen Castro); (6) "Improving Pass Rates in Mathematics Using Interactive Computer Software" (Michelle R. Dedeo); (7) "Enhancing Distance Learning with Multimedia: A Win-Win?" (Timothy J. Ellis and Maxine S. Cohen); (8) "Communication Technologies and Instructional Design" (Michelle R. Howard-Vital and Joanne E. Nottingham); (9) "A Problem-Solving Based Computer Use Course for Non-Majors" (William J. Joel); (10) "Whys and Hows of Teaching Effectively via Interactive Distance Learning" (Jo Jones, Linda Kutilek, Warren Flood, and Nikki Conklin); (11) "Borrowers and Thieves: Internet Plagiarism" (Kathleen King); (12) "Virtual Worlds in Large Enrollment Science Classes Significantly Improve Authentic Learning" (Phillip McClean, Bernhardt Saini-Eidukat, Donald P. Schwert, Brian M. Slator, and Alan White); (13) "Using Streaming Video Technology in Teacher Education" (Edwin McClintock and Zhonghong Jiang); (14) "Anatomy-Physiology as an Intensive, Integrated Lecture/Lab Making It Work" (Holly J. Morris); (15) "Teaching Conceptual Physics through Technology" (V. Adam Niculescu and Peter Martin); (16) "Moving Forward: Marrying Sound Pedagogical Concepts with Learning Technologies" (Julie A. Richardson and Anthony E. Turner); (17) "The Pedagogy of On-Line Instruction in Laboratory Science" (Larry Spears); (18) "A Laboratory for Incorporating Computer Science Theory with Real-World Interests and Difficulties" (Carl W. Steidley and R. Stephen Dannelly); (19) "Unfettered French: Learning Online without the Bounds of Space or Time" (Katherine Watson); and (20) "Caught Up in the Web Who Needs Professors, It's All on the Net" (Peter W. Wright). Each paper contains references. (SLD)

Reproductions supplied by EDRS are the best that can be made
from the original document.

ED 454 758

PERMISSION TO REPRODUCE AND
DISSEMINATE THIS MATERIAL IN MICROFICHE,
AND IN ELECTRONIC MEDIA FOR ERIC
COLLECTION SUBSCRIBERS ONLY,
HAS BEEN GRANTED BY
J. Chambers

TO THE EDUCATIONAL RESOURCES
INFORMATION CENTER (ERIC)
2A



U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION
CENTER (ERIC)
☒ This document has been reproduced as received from the person or organization originating it.
☐ Minor changes have been made to improve reproduction quality.
- Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

SELECTED PAPERS
from the
12th INTERNATIONAL CONFERENCE
on
COLLEGE TEACHING
AND LEARNING

BEST COPY AVAILABLE

Edited by
Jack A. Chambers

HE034115

3

Original Work for Cover Scene
Courtesy of Larry J. Davis, Professor of Art,
Florida Community College at Jacksonville

The Center
for the Advancement of
Teaching and Learning

SELECTED PAPERS from the 12th INTERNATIONAL CONFERENCE on COLLEGE TEACHING AND LEARNING

Edited by
Jack A. Chambers

Florida Community College
at Jacksonville

Copyright, 2001, Florida Community College at Jacksonville. All rights reserved. No part of this publication may be reproduced in any form by any means without prior written permission from the publisher, with the following exceptions: 1) authors of papers published in this volume may reproduce copies of their own articles as indicated in the Publishing Agreement; and 2) reviewers may quote brief passages in review.

Center for the Advancement of Teaching and Learning, *Florida Community College at Jacksonville*, 501 W. State Street, Room 471, Jacksonville, FL 32202.

CONTENTS

Foreword viii

Where Have You Been?-- A Case Study Of Successful Implementation Of Undergraduate Online Learning Communities.
John Barnett
The University Of Auckland 1

A Strange Sense Of Disquietude: Understanding Resistance To Learning Technologies
Siân Bayne
Queen Margaret University College, UK
Ray Land
University of Edinburgh, UK 11

Designing Learning Experiences For Enabling Collaborative Discovery Learning Online
A. Faye Borthick
Georgia State University 25

Humanizing The Interactive Video Conference Experience For Aboriginal Students
W. Dean Care
University Of Manitoba, Canada 35

Using Immersive Virtual Environments To Humanize The Learning Experience
Karen Casto
Western Washington University 43

Improving Pass Rates In Mathematics Using Interactive Computer Software
Michelle R. Dedeo
University Of North Florida 53

Enhancing Distance Learning With Multimedia: A Win-Win?
Timothy J. Ellis
Maxine S. Cohen
Nova Southeastern University 59

Communication Technologies And Instructional Design
Michelle R. Howard-Vital
Joanne E. Nottingham
University Of North Carolina At Wilmington 67

A Problem-Solving Based Computer Use Course For Non-Majors
William J. Joel
Western Connecticut State University 77

Whys And Hows Of Teaching Effectively
Via Interactive Distance Learning
Jo Jones
Linda Kutilek
Warren Flood
Nikki Conklin
The Ohio State University 89

Borrowers And Thieves: Internet Plagiarism
Kathleen King
Idaho State University 97

Virtual Worlds In Large Enrollment
Science Classes Significantly Improve
Authentic Learning
Phillip McClean
Bernhardt Saini-Eidukat
Donald P. Schwert
Brian M. Slator
Alan White
North Dakota State University 111

Using Streaming Video Technology
In Teacher Education
Edwin McClintock
Zhonghong Jiang
Florida International University 119

Anatomy-Physiology As An Intensive, Integrated Lecture/Lab--Making It Work
Holly J. Morris
Lehigh Carbon Community College 133

Teaching Conceptual Physics Through Technology
V. Adam Niculescu
Peter Martin
Virginia Commonwealth University 141

Moving Forward: Marrying Sound Pedagogical Concepts With Learning Technologies
Julie A. Richardson
Anthony E. Turner
King's College, London
Canterbury Christ Church University 149

The Pedagogy Of On-Line Instruction In Laboratory Science
Larry Spears
John A. Logan Community College 163

A Laboratory For Incorporating Computer Science Theory With Real-World Interests And Difficulties
Carl W. Steidley
R. Stephen Dannelly
Texas A&M University – Corpus Christi 171

Unfettered French: Learning Online Without The Bounds Of Space Or Time
Katherine Watson
Coastline Community College 179

Caught Up In The Web-- Who Needs Professors, It's All On The Net
Peter W. Wright
University Of Alberta, Canada 187

Contributors 201

FOREWORD

The Center for the Advancement of Teaching and Learning was developed in 1987 when Florida Community College at Jacksonville (FCCJ) accepted K. Patricia Cross' challenge to use the classroom as a modern laboratory for conducting experiments to gauge the impact of teaching on student learning.

The Center, with the philosophy that classroom teachers are the key to improving student learning, is composed of faculty members under the guidance of a steering committee which consists of faculty from each of four campuses of Florida Community College. Part of the Center's success can be attributed to the numerous opportunities given to faculty to test their teaching ideas and to put research results into practice.

The Center sponsors programs supporting faculty research mini-grants, case studies, portfolios, classroom research, cooperative learning, workshops in online and face-to-face classroom learning and adjunct faculty development. The Center has been the recipient of the Theodore M. Hesburgh Certificate of Excellence for its faculty development programs.

In an effort to stimulate creative discussion and promote experimentation to improve the teaching/learning process, as well as to honor those who have already significantly improved learning in higher education, the Center annually sponsors an international conference. The conference features recognized educational leaders in diverse areas of teaching, learning and technology. Since its inception, the conference has grown yearly and now attracts a thousand scholars from around the world. This annual publication, *Selected Papers*, resulted from faculty interest in preserving and communicating some of the most outstanding contributions to each conference.

Many people are responsible for the success of the conferences. Thanks to all participants--featured speakers and workshop leaders; presenters from universities, liberal arts and community colleges throughout the United States and abroad; and faithful attendees. A special thanks to the Steering Committee for The Center for the Advancement of Teaching and Learning and to Brenda Boccard, Jack Chambers, Jeana Davis, Jessica Weaver and Dennis Lewis.

Like the International Conference, this journal continues to grow and broaden its focus. This year's publication contains articles selected as the 20 best papers from the *Twelfth International Conference on College Teaching and Learning* which represent a cross-section of the nearly 300 faculty presentations. More than 50 papers were submitted for consideration in this year's journal. Those that were selected for inclusion were juried by FCCJ faculty members. Papers were judged on the following criteria:

*Quality of content.

*Quality of writing and presentation

*Focus of the paper (i.e., teaching, learning, technology)

*Discipline

*Appeal to an audience of professional, post-secondary educators

*Theoretical or practical applications

We hope you will find the ideas presented herein applicable and inspirational to your own research and teaching. Please plan to join us at the *Thirteenth International Conference on College Teaching and Learning*, April, 2002, in Jacksonville.

Nadine Whitfield
Professor of Communications

Kathleen Ciez-Volz
Professor of English

John Mullins
Professor of Biology

Jann MacInnes
Professor of Mathematics

WHERE HAVE YOU BEEN?--

A CASE STUDY OF

SUCCESSFUL IMPLEMENTATION

OF UNDERGRADUATE

ONLINE LEARNING COMMUNITIES.

John Barnett
The University of Auckland

INTRODUCTION

This presentation is a personal action research-based case study of the development of the "community" aspects of a Web-based course using few resources, in a part of the world with very low bandwidth. Theories and literature underpinning the course are examined. Principles for creating an online learning community are then derived. The title comes from an incident.

In 1999 and 2000, each of three iterations of the course developed into short-lived learning communities (Lowell & Persichitte, 2000). The case is important because it was the first of its kind--it employed sound pedagogical practice and fully integrated technology at the fourth level of Shaw & Corazzi's (2000) model of utilization.

The course employed a unique platform, CECIL © http://www.cecil.edu similar to commercially available products along with Web Crossing © http://www.webcrossing.com/40/index.html, online computer conferencing software.

Course development did not focus on the technologies (McKenzie, 2000; Ringle, 2000) but rather on issues of values and critically informed choices (Alexander, 1999). Although teaching and learning were situated in a new context (Brown et al., 1989), the course was grounded in the belief that new technologies can enhance the quality of the learning experience (Jurich, 1999).

At first glance the course would have appeared similar to others (Cooper, 1999). There were no special devices to eat up bandwidth! It revolved around interactive lectures called "Backgrounders" similar to Rowntree's (1998) "reflective action guides". It contained pointers to exemplary Websites called "Required Links", weekly online tests, weekly asynchronous threaded discussions on content topics, weekly optional synchronous chats, a collaborative assignment and an individual assignment.

However, the course achieved great success through student word of mouth. So, what made the experience so rewarding? It was the creation of a space where an online learning community could form (Gordin et al., 1996; Harasim, 1997; Hoadley, 1997).

STRUCTURE AND THEORY

Teaching can be characterized as transmission, transaction or transformation. Transmissional education imparts knowledge; transactional shares and creates knowledge; transformational education creates knowledge and changes the participants. To create transformational education, community must be created so that individuals have a social structure in which it is safe to change. A social constructivist structure was created in the online environment because it grounds learning in community-created meaning.

There is a close relationship between meaningful collaboration and the successful use of information and communication technologies (Rich et al, 2000), providing a connection of theory and practice and maximizing learning of students using the online environment (Rossner-Merrill et al., 1998). The course was thus based on students' constructions of their own and the group's meanings and the teacher became a guide and community member.

As the semester progressed, the specific directions of exploration were determined by the skills, knowledge, attitudes and values brought by the individuals. Students developed informational and critical literacies to both access and interact easily with educational information in their virtual formats. They then used their resultant understanding responsibly and purposefully (Todd, 1999). The technologies permitted the presentation of information that took into account different learning modalities and preferences (Baylor, 2000).

The pitfall of an individualistic learning model (Rich et al., 2000) was avoided so that students could experience camaraderie and collaboration that would have occurred in a face-to-face environment (Clark, 2000). In addition, one assignment was based on the development of a solution to a complex problem set in a real world context (Simpson et al., 1999).

CULTURE AND CONTEXT

The online pedagogical context was obviously important; this included factors such as student-teacher interactions, student-to-student relations, social organization of the institution and ties to the local teaching community and the wider society (Newson, 1999). The poverty of contextual cues found in cyberspace and the need to create community underscored the importance of interactions. The course had to be a safe place for all participants. Thus the ground on which the course was based was "constructive critique".

A set of ground rules pre-empted "flaming" (Shapiro & Anderson, 1984). Flaming was explained as interfering with the learning of others, hence breaking the university's rules of student behavior (University of Auckland, 1999). Thus, the ground rules were backed by institutional sanctions.

The discussions of the first few weeks, not surprisingly, tended to be turgid expositions lacking critical analysis of the views of others. However, students knew that embedded in the criteria for assessment of discussion was one that gave value for critiquing ideas that had been presented. Constructive criticism was modelled as a way to critique sensitively without the danger of flaming.

Such constructive criticism was positive, open, transparent and timely. The critique always cast the statement being discussed as of worth, explicitly described as aiding the writer in some way and usually cast as a question that needed greater explanation.

Trust is an important commodity on which community is built. It meant taking personal responsibility and doing what one had promised to do. Transparency was important in this course because student teachers, who will have to create online structures in their teaching careers, needed to see the problems and the solutions.

Scott (2000) noted that prompt and detailed feedback is a key element in flexible learning. In the course there was a built-in 48 hour cushion for replying to student queries. However, it was often faster (although some students asked for even quicker response).

Weekly discussions had clear assessment requirements but they were centered, inviting, rolling and holistic--but subject to refocus. Students made at least two contributions to each week's discussion. Each contribution was graded on the addition, critique or synthesis of views of the course content. The majority of students contributed more times than required and in much greater length.

Opening a new discussion weekly portrayed the course authentically as one in continuous development. Without predefined set of outcomes, it invited co-construction of knowledge. Although each week started with a topic, it invariably veered off trajectory. Some discussions related facts and theories raised in previous weeks and made useful theoretical comparisons or made forward links to topics.

However, the students would inevitably refocus the discussion. None of the discussions that went off track failed to come back. It is quite possible that it was a result of assessing the discussion contents. Perhaps the more conscientious students began to worry about the grading of their contributions to an off-focus discussion. Hence, moderation was--had to be--flexible and loose.

Each week, a chat was held late on Saturday morning. Each chat lasted one hour and students were given a small credit for participation. Some students came into the university to participate, others participated from home, while others joined from cyber cafes when they were away from the area.

The events were highly popular with students. The purpose was to provide a community space. They were light-hearted, connecting and transitory. In marked contrast to the often weighty discussions, chats were cheerful events. Often, several conversations occurred simultaneously and students learned that they needed to develop skills in decoding strands of simultaneous interactions.

Students often used the chats to ask questions. However, a group e-mail was often needed to clarify the answers to questions. Chats were also not useful in making group decisions. Students felt connected by being in the same cyber space at the same time. It became apparent that social roles of class members became defined in similar ways as face-to-face classes.

There was little doubt that the sense of the class as a community coalesced in the chats. However, chats place ESOL students at disadvantage, along with poor typists and those who cannot keep track of multiple conversation strands. Chat sessions are also transitory. Having them available at a special time made each special and motivated students to attend.

CONCLUSIONS

An online learning community is a time-limited virtual community. It does not need the newest technologies to flourish. Like any community it is based upon the structure and qualities of its interactions. The interaction style should include constructive critique that is positive, open, transparent and timely. Interactions should be assessed in clear and simple terms but allowed to explore tangential issues for short periods of time. Interactions should engage both synchronous and asynchronous communication channels.

Discussions should be centered, inviting, rolling, and holistic but subject to refocus. Discussions should be moderated in ways that are flexible and loose. Control of the debate should be open enough to allow students to make their own meanings. Chats should be light-hearted, connecting and transitory.

The elements of an online learning community, like that of community anywhere, is centered in its interactions, not the technologies that underpin them. Paying close and careful attention to those interactions is an exercise that will always pay off in online education.

REFERENCES

Alexander, T. (1999). ICT in education: Why are we interested? What is at stake? *TechKnowLogia*, 1(2). [On-line]. Available: www.techknowlogia.org/TKLactivepages2/CurrentArticles/main.asp?IssueNumber=2&FileType=HTML&ArticleID=36

Baylor, A. L. (2000). Cognitive strategies for training with technology. *TechTrends, 44*(5), 13.

Brown, J., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher, 18*(1), 32-42.

Clark, J. (2000). Collaboration tools in online learning environments. *ALN Magazine, 4*(1). [On-line]. Available: http://www.aln.org/alnweb/magazine/Vol4_issue1/Clark.htm

Cooper, L. (1999). Anatomy of an online course. *T.H.E. Journal, 26*(7), 49.

Gordin, D. N., Gomez, L. M., Pea, R. D., & Fishman, B. J. (1996). Using the world wide web to build learning communities. *Journal of Computer Mediated Communication,* 2(3). [On-line]. Available: www.ascusc.org/jcmc/vol2/issue3/gordin.html

Harasim, L. (1997, March). Network learning: What have we learned and what does it mean? In B. Fishman (Chair), *Collaboration, communication, and computers: What do we think we know about networks and learning?* Interactive symposium conducted at the annual meeting of the American Educational Research Association, Chicago.

Hoadley, C. (1997, March). Scaffolding communication for learning through structured media. In B. Fishman (Chair), *Collaboration, communication, and computers: What do we think we know about networks and learning?* Interactive symposium conducted at the annual meeting of the American Educational Research Association, Chicago.

Jurich, S. (1999). Virtual education: Trends and potential uses: A review of literature. *TechKnowLogia, 1*(2). [On-line]. Available: www.techknowlogia.org/TKLactive pages2/Current/Articles/main.asp?FileType=HTML&ArticleID=44

Lowell, N. O., & Persichitte, K. A. (2000). A virtual ropes course: Creating online community. *Asynchronous Learning Networks Magazine 4*(1). [On-line]. Available: www.aln.org/alnweb/magazine/Vol4issue1/Lowell.htm

McKenzie, J. (2000). First things first: Networking for student learning. *From Now On: The Educational Technology Journal, 10*(3). [On-line]. Available: http://fno.org/nov00/fl.html

Newson, J. (1999). Techno-pedagogy and disappearing context. *Academe, 85*(5), 52-55.

Rich, D. C., Robinson, G., & Bednarz, R. S. (2000). Collaboration and the successful use of information and communications technologies in teaching and learning geography in higher education. *Journal of Geography in Higher Education, 24*(2), 263-270.

Ringle, M. (2000). Technology innovation: Thriving at breakneck speed. *Educause Review, 35*(4), 94.

Rossner-Merrill, V., Parker, D., & Mamchur, C. (1998). Using constructivist instructional design featured in two online courses: Notes from the field. *Educational Media International, 35*(4), 282.

Rowntree, D. (1998). Assessing the quality of materials-based teaching and learning. *Open Learning, 13*(2), 12-22.

Scott, G. (2000, August). *Creating a more flexible and responsive learning environment in higher education.* Paper presented at the Quality Enhancement Meeting Five, Victoria University and the NZ Academic Audit Unit, Wellington, New Zealand.

Shapiro, N. Z., & Anderson, R. H. (1984*). Toward an ethics and etiquette for electronic mail* (Report R-3283-NSF/RC). Santa Monica: RAND Corporation. [Online]. Available: http://www.rand.org/publications/MR/R3283/

Shaw, M, & Corazzi, S. (2000). Avoiding holes in holistic evaluation. *Educational Technology & Society, 3*(4). [Online]. Available: http://ifets.massey.ac.nz/periodical/vol42000/shaw.html

Simpson, M., Payne, F., Munro, R., & Hughes, S. (1999) Using information and communications: Technology as a pedagogical tool: Who educates the educators? *Journal of Education for Teaching, 25*(3), 247-262.

The University of Auckland (1999). *Disciplinary statute* (p.625-628). Auckland, New Zealand: The University of Auckland Calendar.

Todd, R. J. (1999). Transformational leadership and transformational learning: Information literacy and the World Wide Web. *NASSP Bulletin, 83*(605), 4-12.

A STRANGE SENSE OF DISQUIETUDE: UNDERSTANDING RESISTANCE TO LEARNING TECHNOLOGIES

Siân Bayne
Queen Margaret University College, UK
Ray Land
University of Edinburgh, UK

INTRODUCTION

Many practitioners have commented on the way in which some learners give a higher status to study in a face-to-face environment than that which is mediated by technology (Akers, 1997; Finkelstein & Dryden, 1998; Grint, 1989; Von Prummer, 1995). One evaluator reports, for example:

> The issue of whether teaching delivered by videoconferencing was as good as the face-to-face equivalent elicited the most consistently negative response...Frequent comments were that having a session like this was better than no session at all, but couldn't ever be as good as a face-to-face session. One group quantified this by commenting that their videoconference session had been only about half as useful as a face-to-face session…videoconference teaching wasn't as good as 'the real thing' but was better than no session at all.
>
> (Cook, 1999)

Another, this time referring to computer mediated conferencing, reports one student as commenting:

> It is a cold medium. Unlike face-to-face communication you get no instant feedback. You don't know how people responded to your comments; they just go out into silence. This feels isolating and unnerving. It is not warm and supportive.
>
> (Wegerif, 1998, p. 138)

What emerges strikingly from these, and other, studies is the way in which some learners see technology-mediated teaching as not merely a second best solution, but as one which is somehow *inauthentic*, not "the real thing". Suggestions as to why this should be so range from those founded on the pedagogical and technological practicalities of teaching using technology, through social presence theory and the concern with reduced social cues, to the more determinist social learning approaches, which suggest that we are hardwired for specific types of social interaction. Often, such resistance is not theorized at all--it is intuited, a matter of "common sense", that face-to-face is simply better. Its immediacy, the embodied presence of learner and teacher, makes it "real".

This paper will attempt to problematize these assumptions, drawing on post-modern theories of identity and presence in order to gain insight into why many learners (and indeed teachers) feel uneasiness with certain technology-assisted approaches.

POST-MODERNITY AND TECHNOLOGY-ASSISTED LEARNING

The state of post-modernity is characterized by a shift away from enlightenment "foundationalism"--from the belief that knowledge is the reflection of the truth and that it has a stable foundation in God, Humanity or Reason. Jean-François Lyotard (1985) describes it as a loss of belief in the "meta-narrative", the totalizing "story" which provided us with a touchstone of universal truth and meaning and which allowed us to anchor our everyday lives and our positions in the world.

In post-modernity, ideas about knowledge and truth become fragmented, we cannot totalize them because there is no space outside culture from which to view culture. Knowledge and communication can only take place within the language and thought systems with which we are involved, and objectifying truth becomes an impossibility. In its place we must accept a "centerless" world, one in which communication and meaning is generated through language games, and in which the acceptance of heterogeneity and incommensurability replaces reliance on stable meanings and fixed truths.

Many see this shift as a positive change, one which liberates us from the totalizing force of rational systems of thought and enables us to embrace that which reason excludes--the aesthetic, the playful, the ironic, the acceptance of multiplicity and *difference* in the world and in ourselves. Others see the post-modern condition as one dominated by anxiety, irrationalism and helplessness, a state that breeds a sense of moral relativism and of fragmentation of self and society.

There is a sense in which the computer can be seen as the ultimate post-modern artifact. As Sherry Turkle (1996) points out, "Computers embody post-modern theory and bring it down to earth" (p.18).

In general, computer technology fosters a culture of simulation, of playful experimentation and of navigation over surfaces which is distinctively post-modern. The Web in particular--sprawling, limitless, consisting of endless, unstable, changing elements, each one potentially linked to each other and therefore bearing within it infinite traces or connective possibilities--embodies the characteristics the post-structuralist brand of post-modernism sees in language systems (Bayne & Land, 2000). As Johnson-Eilola (1998) indicates, engaging with these technologies from within the context of modernistic foundationalism can be a cause of acute anxiety:

> Our panic intensifies when we are confronted by communications technologies such as computers interconnected on a global scale. In these articulations, post-modernism abducts modernist technologies: the computer…is reconstructed and redistributed to provide a fluid, flowing space where users experiment with multiple subjectivities; where stories lose concrete beginnings, middles and ends; where the rules of games shift, are overwritten, and sometimes even disappear. We, who Foucault once termed 'the pious descendants of time' (Foucault., 1986, p. 22), do not understand or relate to these networked spaces. (Johnson-Eilola, 1998, p. 186)

Much university education, particularly that in the scientific rationalist tradition, emerges from the foundationalist ideas described above, from the assumption that there is a hidden core of truth which can be extracted with the correct application of reason, from an unbiased position of objectivity. Perhaps it is unsurprising, therefore, that when we are asked to learn with a tool which in a sense embodies the antithesis of these ideas, some of us experience a sense of disorientation, even of "panic".

A SENSE OF PRESENCE

We have already discussed the idea that technology-mediated learning is seen by some as being second-best, somehow less authentic than that experienced face-to-face. The post-structuralist approach to the idea of presence can perhaps give some insight into why this should be so.

The philosopher Jacques Derrida (1988) sees the history of Western philosophy as being based in "logocentrism"--the belief in some center, some ultimate word ("logos"), truth or reality which anchors all thought, language and experience and provides an ultimate meaning which cannot be questioned. Notions of God, Truth, the Self, Nature and so on can all be seen as having their roots in logocentrism which, for Derrida (1988), is closely bound up with what he calls the "metaphysics of presence".

> Presence appears as the things we see; as the immediacy of the ideas and representations we have; as substance, essence and existence. Presence constitutes the essential truth of reality; hidden from our sight possibly, but present in its entirety to some divine mind. (Derrida, 1988, p. 110)

Post-structuralist thought stresses that any such transcendental meaning is merely constructed. There is no concept which exists outside systems of thought and language; there is no concept which is not involved in the infinite play of meaning which characterizes the post-structuralist vision of language.

This notion of presence underpins traditional Western ideologies and value structures (humanism, positivism, foundationalism) in that it enables the construction of a network of conceptual hierarchies dependent on the function of binary oppositions. Examples of such oppositions would be mind/body, male/female, white/black, self/other, nature/culture, good/evil and so on.

The relationship between each set of the above terms is hierarchical--in each of these oppositions, the former term is dominant, while the latter is seen as a deviance from or perversion of it. The key point is that the dominant term is always that which "belongs to presence and the logos", it is that which has the status of "truth", of "rightness" (Culler, 1983).

If we extend this idea into the context of teaching and learning we can come up with a set of hierarchical terms which include: teaching/learning; competition/collaboration; teacher/learner; synchronicity/asynchronicity; research/teaching; face-to-face/distance-mediated. Again, in traditional thought at least, dominance and presence reside in the former terms and we can see many of the terms which best describe technology-assisted approaches (learner centeredness, collaboration, asynchronicity, distance) relegated to the subordinate position.

The opposition presence/absence is key in the above scheme. And, of course, many forms of computer-assisted communication--computer-mediated conferencing, video-conferencing--are characterized by "absence". Perhaps it is not surprising, therefore, that we often see technology-assisted learning perceived as a "second best" option.

Post-structuralist theory can also throw light on the perceived *inauthenticity* of technology-assisted learning, particularly that which takes place through text-based computer mediated conferencing on bulletin boards and in chat rooms. Computer mediated conferencing is a textual mode of communication--it does not involve speech. It is characterized in most instances of its use by its other distinctive aspect--asynchronicity (as we have seen, asynchronicity takes a secondary position in the conceptual hierarchy described above, being seen as subordinate to synchronicity and presence).

For Derrida (1988), the speech/writing opposition is key. We privilege speech, in that it appears to us to emanate directly from its author. It therefore appears to provide more immediate and unmediated access to his or her thought than does writing. In addition, the presence of the author is self-evidently required for speech--presence, in the sense of physical presence, requires synchronicity.

A logocentric perspective would not question the assumption that words spoken, in real time, have an immediacy and validity that words written, asynchronously, simply do not have. The kind of exchange which takes place online is heavily and obviously mediated both through written text and computer technology. Face-to-face, in comparison, appears to approximate far more closely to reality, to "here-ness" or presence. Text-based conferencing therefore comes to be perceived as inauthentic. The basis of such perception is rarely articulated--instead we get the intuitive sense, as described earlier, that face-to-face just *feels* better.

A SENSE OF IDENTITY

It is frequently noted that students behave differently in online computer mediated conferencing groups than they do face-to-face. Those who are quiet and withdrawn in conventional tutorials may become articulate and active contributors online; those who feel they "stand out" in a face-to-face situation--because of gender, color, disability--may feel empowered by the lack of visual cues online and be more comfortable about taking a full part in discussion and debate (McConnell, 1990; Rimmershaw, 1998).

Such examples can be seen as positive manifestations of the way in which communication online can actively challenge traditionally accepted notions of identity, enabling us to construct different versions of ourselves, to play with multiple aspects of our personalities, unconstrained by the social roles and hierarchies inscribed in face-to-face contexts. For some, this is emancipatory, while for others it is a cause of deep-seated anxiety. Post-modern theories of identity suggest that this is chiefly because another fundamental humanistic assumption--that of the existence of a single, stable identity--is being brought into question by the mediation of technology. According to Turkle (1996):

> When people adopt an online persona they cross a boundary into highly-charged territory. Some feel an uncomfortable sense of fragmentation, some a sense of relief…. The many manifestations of multiplicity in our culture, including the adoption of online personae, are contributing to a general reconsideration of traditional, unitary notions of identity. (p.260)

The word "identity" has its root in the Latin *idem*, meaning "same"; the traditional view of identity is that it is something fixed, something that remains the same throughout time and supplies a unity throughout the diversity of cultural and personal experience. The conception of the self in this scheme is one of a coherent entity centered around a stable core of autonomous and rational subjectivity. It is inherited from Descartes (Clarke, 1999) who posited consciousness as the guarantee of human identity "I think therefore I am" and forms the basis of the liberal humanism which still informs much educational theory and practice.

Freud's (Strachey, 1966) notion of the unconscious fundamentally challenges this assumption. For Freud, the self is not unified but is rather conceived as a battleground upon which conscious and unconscious forces contest with each other. Later, post-structuralist psychoanalysts and theorists saw the human subject as being even more radically fragmented.

Jacques Lacan (1977), for example, in his re-reading of Freud, proposes that the human subject is fundamentally "split". This split begins to occur when the infant first recognizes its own reflection in a (not necessarily literal) mirror somewhere between the ages of six and eighteen months. At this moment the child begins to recognize itself as an object separate from the things and the people which surround it. It begins to construct an identity.

At the same time, the reflection the infant sees represents an unattainable version of the child's self, in that it appears complete, integral and "in control", whereas the infant itself is still uncoordinated and not in full control of its own movements and functions. The image the child sees both is and is not itself.

As Lacan (1997) writes "the human individual fixes upon himself an image that alienates him from himself" (p. 19). In Ellman's (1994) words, the child "literally loses himself in his own reflection" (p. 17). The wholeness and harmony which the infant experiences in its early relation to its mother and its world is fractured and the construction of the child as a "subject" begins.

For Lacan (1977), this initial split or alienation is reinforced when the child begins to use language. Language is not seen as a skill which the child learns--it is the world which the child enters and which creates its identity and structures its unconscious. It exists outside the subject and cannot be controlled by it. Our identity is not innate but is linguistically formed and therefore subject to the same decenteredness and instability that post-structuralists see in language systems.

Sherry Turkle (1996) describes how these rather esoteric ideas gain a new immediacy within the context of technology-mediated communication:

> I am meeting [these ideas] again in my new life on the screen. But this time the Gallic abstractions are more concrete. In my computer-mediated worlds, the self is multiple, fluid, and constituted in interaction with machine connections; it is made and transformed by language;...and understanding follows from navigation and tinkering rather than analysis. (p. 15)

Kenneth Gergen (1991) reiterates the notion of the self as a social construct in his idea of "the saturated self". He sees personal identity as a complex interweaving of social relationships. Through communication technology we are saturated with the "many voices of humankind":

> We realize increasingly that who and what we are is not so much the result of our 'personal essence' but of how we are constructed in various social groups...We appear to stand alone, but we are manifestations of relatedness. (p. 113)

CONCLUSIONS

Gergen (1991) himself acknowledges that there is likely to be resistance, an uneasiness, with what appears to be a breakdown in identity. Turkle (1996) also characterizes the changes in the conception of self which occur online as being about "identity crisis", despite her assertion that:

> Internet experiences help us to develop models of psychological well-being that are in a meaningful sense post-modern: they admit multiplicity and flexibility; they acknowledge the constructed nature of reality, self, and other. (p. 263)

At some level, learning to engage in communication online involves learners in a questioning of their own identity. This can perhaps help us to understand why many find it to be a strangely disconcerting experience, one which seems alienating and "cold". Such engagement in what are not only novel learning environments but in many ways unfamiliar modes of experiencing selfhood requires a tolerance of ambiguity and complexity, and an acceptance of uncertainty which does not fit easily in modernist higher education environments, with their emphasis on rationality, stability and clearly defined boundaries and hierarchies.

The primary characteristics and strengths of the new learning technologies are that they enable and, in fact, necessarily involve connectivity, collaborative effort, the interweaving of ideas, multi-vocality and the bringing into play of multiple perspectives and resources. This state of ambiguity and plurality is disquieting not only for the traditional academy and its knowledge structures, but also for its individual learners.

It is important, however, to stress that there is nothing about the properties of technology-assisted learning environments that learners cannot develop strategies to handle. Rushkoff (1997), in his study of the "children of chaos"--or "screenagers"--describes how the new generation of people now approaching university age have found, through their handling of computer simulations and gaming, a means of thriving in environments of uncertainty and complexity:

> Our children, ironically, have already made their move. They are leading us in our evolution past linear thinking, duality…toward a holistic, animistic, weightless and recapitulated culture. Chaos is their natural environment. (Rushkoff, 1997, p. 269)

It remains to be seen whether, as the generation Rushkoff describes enters the world of higher education--a generation more confident with the experience of ambiguity and discontinuity--the anxiety, resistance and perceived isolation of some of the present generation of online learners might become transformed into a similar confident engagement. Only by being aware of some of the fundamental cultural issues at stake as we move further into the electronic age are we able to support not only learners experiencing transitional anxiety, but also those future generations who have already come fully to terms with new ways of knowing.

REFERENCES

Akers, R. (1997). *Web discussion forums in teaching and learning.* [On-line]. Available: http://horizon.unc.edu/TS/cases/1997-08a.asp

Bayne, S., & Land, R. (2000). Learning in the labyrinth: Hypertext and the changing roles of instructor and learner in higher education. *Proceedings of EDMEDIA 2000, World Conference on Educational Multimedia, Hypermedia & Telecommunications*, Montreal, Canada.

Clarke, D. M. (Ed.). (1999). *Descartes: Discourse on method and related writings.* London: Penguin.

Cook, J. (1999). *Acceptance of video-conferencing in medical and dental education.* Unpublished raw data.

Culler, J. (1983) *On deconstruction.* London: Routledge and Kegan Paul.

Derrida, J. (1988) Structure, sign and play in the discourse of the human sciences. In D. Lodge (Ed.), *Modern criticism and theory* (pp. 108-123). London: Longman.

Ellman, M. (1994). *Psychoanalytic literary criticism.* London: Longman.

Finkelstein, D., & Dryden, L. (1998). Cultural studies in cyberspace: Teaching with new technology. *Asynchronous Learning Networks Magazine* 2(2). [On-line]. Available: http://www.aln.org/alnweb/magazine/vol2_issue2/finkelstein.htm

Foucault, M. (1986). O4 other spaces. *Dialectics,* 22-27.

Gergen, K. (1991). *The saturated self: Dilemmas of identity in contemporary life.* New York: Basic Books.

Grint, K. (1989). Accounting for failure: Participation and non-participation in CMC. In R. Mason & A. Kaye (Eds.), *Mindweave: Communication, computers and distance education* (pp. 189-192). New York: Pergamon.

Johnson-Eilola, J. (1998), Living on the surface: Learning in the age of global communication networks. In I. Snyder (Ed.), *Page to screen: Taking literacy into the electronic era* (pp. 185-210). London: Routledge.

Lacan, J. (1977). Aggressivity in psychoanalysis. In *Ecrits: A selection* (A. Sheridan, Trans.). London: Tavistock.

Lyotard, J. F. (1985). *The postmodern condition*. Manchester: Manchester University Press.

McConnell, D. (1990). The educational use of computer conferencing. *Educational and Training Technology International*, 27 (2), 190–208.

Rimmershaw, R. (1998). Supporting a culture of collaborative study. In Author (Ed.), *Networked lifelong learning: Innovative approaches to education and training through the Internet.* University of Sheffield, UK.

Rushkoff, D. (1997). *The children of chaos*. London: Flamingo.

Strachey, J. (1966). *The complete psychological works of Sigmund Freud* (vols. I-XXIV). London: Hogarth Press.

Turkle, S. (1996). *Life on the screen: Identity in the age of the Internet.* London: Phoenix.

Von Prummer, C. (1995). Putting the student first? Reflections on telecommunication and electronic leading strings. In A. Tait (Ed.), *Putting the student first: Learner centred approaches in open and distance learning.* Collected Conference papers: Sixth Cambridge International Conference on Open and Distance Learning, Cambridge, UK.

Wegerif, R. (1998). The social dimension of asynchronous learning environments. *Journal of Asynchronous Learning Networks,* 2(1), 34-49. [On-line]. Available: http://www.aln.org/alnweb/ journal/ jaln_vol2issue1.htm

DESIGNING LEARNING EXPERIENCES FOR ENABLING COLLABORATIVE DISCOVERY LEARNING ONLINE

A. Faye Borthick
Georgia State University

INTRODUCTION

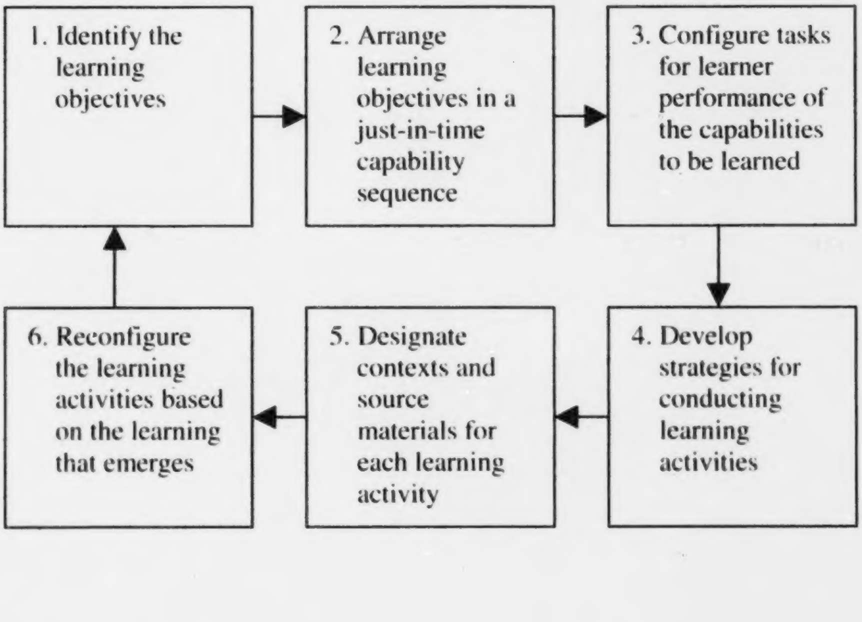
This paper describes a process for designing technology-enabled learning experiences for collaborative discovery learning online. In discovery learning, learners are guided to recognize a problem, characterize what a solution would look like, search for relevant information, develop a solution strategy, and execute the chosen strategy. The internalization of capabilities that constitutes learning is, however, as much a social as an individual cognitive phenomenon (Vygotsky 1978; 1986; Wenger 1998). The essence of the design process is to configure learning experiences within learner zones of proximal development and situate learners in an electronically-enabled community of practice that creates opportunities for learners to construct their own understandings in the social context.

A DESIGN PROCESS FOR TECHNOLOGY-ENABLED LEARNING EXPERIENCES

Phase 1: Identify the Learning Objectives

The first phase in the design process (Figure 1) is to identify the learning objectives and state them in language that specifies what learners will be able to do upon mastering the capabilities the objectives represent. This performance conception of understanding emphasizes "performances that can be observed, critiqued, and improved" (Gardner, 1999, p. 73). As they develop into bona fide members of a community of practice, neophytes acquire the behaviors expected of practicing members of the community. Learners are prompted to identify with the community rather than with the passivity of just "learning school". Thus, learning "becomes a progressive process of attempting more and more challenging understanding performances" (Perkins & Unger, 1999, p. 97) that gradually expand the learners' capabilities.

Figure 1. Design Phases


1. Identify the learning objectives
2. Arrange learning objectives in a just-in-time capability sequence
3. Configure tasks for learner performance of the capabilities to be learned
4. Develop strategies for conducting learning activities
5. Designate contexts and source materials for each learning activity
6. Reconfigure the learning activities based on the learning that emerges

Phase 2: Arrange the Learning Objectives in a *Just In Time* Sequence

The second phase in configuring tasks is to arrange the learning objectives in sequences that permit learners to gain the requisite readiness for proceeding with learning associated with the next objective. Depending on the capabilities to be acquired, there may be several simultaneous factors to be considered in the arrangement of learning objectives. For example, it may be helpful to think though the implications of choosing between a top-down order (high-level objective first) and a bottom-up order (low-level objective first).

Phase 3: Design Tasks for Learner Performance of Capabilities to be Learned

A central premise of zones of proximal development and the associated sociocultural theory is Vygotsky's (1978; 1986) idea that developing mental function depends on learners internalizing the performance of the capabilities they are learning. Electronic social interaction can promote collaboration in assisted-learning situations. For example, learners may have tasks they are learning to perform for which assistance can be provided electronically, through collaboration with other learners or by a facilitator. The assistance can be provided asynchronously or synchronously.

Phase 4: Develop Strategies for Conducting Learning Activities

Once learning experiences for a learning objective have been identified and sequenced, the facilitator can develop strategies for conducting the learning experiences. The facilitator's objective is to weave different kinds of assistance together to create a rich instructional conversation that supports rather than directs learners' performance (Tharp, 1993). Some techniques in the sociocultural tradition for supporting learner performance are: 1) modeling that sets performance standards and makes invisible processes evident; 2) coaching to guide learners to expert performance; 3) scaffolding to support otherwise unattainable performance and fading to remove the support as proficiency increases; 4) questioning to elicit responses that reveal mental functions learners cannot produce on their own; 5) encouraging learner exploration and application of problem-solving capabilities; 6) fostering learner reflection and self awareness of performance; 7) providing cognitive task structuring through explaining and organizing tasks within learners' zones of proximal development; 8) managing instruction with feedback and reinforcement; and 9) using direct instruction for ensuring clarity and supplying missing information (Bonk & Kim, 1998; Collins et al., 1989).

Phase 5: Designate Contexts and Source Materials for Each Learning Activity

For each learning experience, the facilitator must designate the situation (the context) in which learners are to perform the capability they are learning and source materials that set the stage for learners' performance of it. The source materials need to make manifest aspects such as the context with appropriate richness, a rationale for why the capability is worthy of performance in the community of practice, a portrayal of the consequences of performing the task at different levels of proficiency, any authoritative literature or other reifications pertaining to the performance of the task, guidance for getting started with the task and directions for participating in asynchronous and synchronous collaboration in performing the task. The complexity of the source materials may vary as a function of the learners' zones of proximal development.

Phase 6: Reconfigure the Learning Activities Based on the Learning that Emerges

With each learner group that performs the task, the facilitator has the opportunity to observe whether the learners attained the desired level of mastery. Evidence about mastery may be manifest in the form of class discussion of group submissions, learner ratings of group submissions, facilitator assessment of group submissions, learner participation in chat (including what questions learners ask and how they respond to probing questions from the facilitator), exam performance, interim practice question performance, and learners' ability to move to the next objective.

At junctures where learners did not achieve the desired mastery, the facilitator could develop a strategy for improving the learning experience by reconfiguring one or more aspects of the learning scaffold or enhancing learners' zones of proximal development through prior learning experiences. If learners exceeded the desired mastery, the facilitator has an opportunity to prompt a higher level of mastery by adjusting the context or to maintain the mastery level while removing some of the scaffold or other assistance. The situation of learners failing to attain the desired mastery should prompt the facilitator to reconstitute one or more of the context, the task, the scaffold, or prior learning experiences.

RESULTS FROM AN INFORMATION SYSTEMS ASSURANCE COURSE

The design process has been implemented in a master's course in information systems assurance taught as collaborative discovery learning (Borthick & Jones, 2000). The course is completely online with Web sites for all class materials, bulletin board discussions, chat for class sessions, Web sites for publication of student work and chat logs, and Web administration of exams. The syllabus links to specifications for learning experiences (http://www.gsu.edu/~accafb/ac863.htm) and explains the use of the technology platform. Dialog from an online discussion session is analyzed in Borthick (in press), and a learning experience for database querying configured for varying zones of proximal development is presented in Borthick, et. al. (in press).

In a comparison of the last face-to-face term with three subsequent online terms, the online course was at least as effective as the traditional, face-to-face method. An analysis of variance, adjusted for student GPA, was performed on final exam scores among students in the four sections. Statistically non-significant differences were found, which is consistent with the literature. The students also completed a college-administered evaluation of instructor performance. The means from the evaluation indicate greater satisfaction with the online course.

CONCLUSIONS

This paper developed a process for configuring learning experiences within learners' zones of proximal development and situating them in an electronically-enabled community of practice that creates opportunities for learners to construct their own understanding in the social context. Configuring learning tasks in zones of proximal development shifts the role of the teacher from communicating content to engaging learners in the construction of their own competence.

Rather than being passive recipients of knowledge, learners negotiate their own meanings in social contexts.

Instead of simply absorbing others' ideas, learners discuss, analyze, evaluate, and internalize their own understandings in the domain. Instead of presenting knowledge, the teacher becomes a designer of learning experiences and a facilitator of the interaction. Insisting that learners build their own competence has the potential to prepare learners for work environments in which new problems are the norm and groups of professionals work together to solve them.

This approach provides a guide to facilitators for incorporating the use of information and communications technology into learning experiences implemented in partial or completely virtual spaces. For example, the synchronous sessions could be held face-to-face in spaces in which every learner has a networked computer. This approach would allow facilitators to develop proficiency in conducting class sessions in which learners are actively engaged in the performance of the task, which would help facilitators develop the ability to conduct synchronous sessions. When desktop video conferencing with application sharing becomes commonplace, learners and the facilitator will be able to see video of the other participants and share access to an application, which will permit simultaneous collaboration on any document or application.

This process for configuring learning experiences creates opportunities for faculty to develop their own repertoire of capabilities in designing and facilitating learning experiences. Christensen's (1997) advice for e-commerce ventures seems appropriate: "get the first models done fast and on a shoestring—leaving ample budget to get it right once feedback from the market starts coming in" (p. 196). For configuring learning experiences, the limiting budget comprises faculty time and energy. In essence, this means anticipating being wrong and learning what promotes learning as fast as possible.

Lastly, deploying this process in virtual learning spaces has the potential of helping learners develop their capabilities for practicing in virtual work environments. In these environments, professionals collaborate electronically, which allows them to transcend time and distance constraints. As virtual work environments become more commonplace, learners will benefit from having experienced them in authentic settings, supported by a learning scaffold configured in their zones of proximal development.

REFERENCES

Bonk, C. J., & Kim, K. A. (1998). Extending sociocultural theory to adult learning. In M. C. Smith & T. Pourchot (Eds.), *Adult learning and development: Perspectives from educational psychology* (pp. 67-88). Mahwah, NJ: Erlbaum.

Borthick, A. F. (in press). Analysis of design from a community of practice dialog: Negotiating the meaning of auditing information system development. *Journal of Information Systems.*

Borthick, A. F., & Jones, D. R. (2000). The motivation for collaborative discovery learning online and its application in an information systems assurance course. *Issues in Accounting Education, 15*(2): 181-210.

Borthick, A. F., Jones, D. R., &. Kim, R. (in press). Developing database query proficiency: Assuring compliance for responses to Web site referrals. *Journal of Information Systems.*

Christensen, C. M. (1997). *The innovator's dilemma: When new technologies cause great firms to fail.* Boston: Harvard Business School.

Collins, A., Brown, J. S., & Newman, S. E. (1989). Cognitive apprenticeship: Teaching the crafts of reading, writing, and mathematics. In L. Resnick (Ed.*), Knowing, learning, and instruction: Essays in honor of Robert Glaser* (pp. 453-494). Hillsdale, NJ: Erlbaum.

Gardner, H. E. (1999). Multiple approaches to understanding. In C. M. Reigeluth (Ed.), *Instructional-design theories and models: A new paradigm of instructional theory* (pp. 69-89). Mahway, NJ: Erlbaum.

Perkins, D. N., &. Unger, C. 1999. Teaching and learning for understanding. In C. M. Reigeluth (Ed.*), Instructional-design theories and models: A new paradigm of instructional theory* (pp. 91-114). Mahway, NJ: Erlbaum.

Tharp, R. (1993). Institutional and social context of educational reform: Practice and reform. In E. A. Forman, N. Minnick, and C. A. Stone (Eds.*), Contexts for learning: Sociocultural dynamics in children's development* (pp. 269-282). New York: Oxford University Press.

Vygotsky, L. S. (1978). Mind in society: The development of higher psychological processes. Cambridge, MA: Harvard University Press.

Vygotsky, L. S. (1986). *Thought and language*. Cambridge, MA: MIT Press.

Wenger, E. (1998). *Communities of practice.* Cambridge: Cambridge University Press.

HUMANIZING THE INTERACTIVE VIDEO CONFERENCE EXPERIENCE FOR ABORIGINAL STUDENTS

W. Dean Care
University of Manitoba, Canada

INTRODUCTION

It is well know that Aboriginal people are under-represented in science, technology, and health-related programs and professions (MacIvor, 1995). In order to facilitate greater representation of Aboriginal students in professional programs, educators must first understand their perspectives as they encounter the traditional educational system of colleges and universities.

The purpose of this evaluative study was to explore the learning experiences of remotely located Aboriginal nursing students studying at a distance using interactive video technology. By examining and describing the experiences of students, educators are able to understand what contributes to persistence in this learning environment. The goal of this initiative was to improve course delivery to remote program sites and ultimately enhance student learning and retention.

Interactive video technology is an educational medium that allows the transmission of audio signals and video images across telephone lines. This delivery method supports two-way communication and, as such, is fully interactive. Interactive video technology allows teachers to overcome barriers of distance by coming as close as possible to simulating the classroom situation. Remotely located students meet in a designated classroom specially equipped with cameras, microphones, data projector, videoconference codec and a television screen.

Aboriginal students can be considered a minority group in the traditional university environment and as such are “at risk” of being unsuccessful (Campbell & Davis, 1996). For the most part, university curricula represents the dominant Anglo-European, middle-class culture. According to Crow (1993), this educational perspective is “linear, sequential, time-oriented, individualistic, competitive, dualistic, and with a domination of nature” (p. 199).

Crow (1993) describes the Native world view as being “perceived through a circular or spiral thought process or patterning, which is holistic, pluralistic, and framed in an event orientation that emphasizes cooperating groups” (p. 199). Lipson, Dibble, and Minarik, (1996) describe the academic culture as being dominated by the belief that human condition can be improved by technology and science. The conflicting values that exist between Aboriginal students and the college or university environment are summarized in Table 1.

Table 1. Comparison of Conflicting Values

Aboriginal Students	Academic Culture
Orientation to events	Orientation to time
Group learning	Individualistic
Cooperative	Competitive
Observation-imitation	Trial-and-error
Holistic orientation	Liner, sequential orientation
Oneness with nature	Domination of nature
Visual, auditory	Verbal

The evolution of educational technology is rapidly creating a demand for access to institutions of higher learning (Bates, 2000). The use of interactive video technology enables teachers to have a presence felt at the remote site. Interactive video technology has the distinct advantage of preserving real-time interaction between students and the teacher and among students at the on-campus and remote sites. This medium is visually stimulating and can be used to engage learners from all program sites in meaningful dialogue. However, Chandler and Hanrahan (2000) caution that "the presence of a television screen in the classroom automatically puts students in the passive role" (p. 77). This barrier can be overcome with a humanistic, learner-centered approach to course delivery.

Empirical evidence supports the claim that students learn equally as well by interactive video as by traditional classroom offerings. However, studies by Hansen & Irvin (1996) and La Salle (1996) report complaints of students feeling disconnected from faculty and intimidated by the equipment. It is clear that the benefits and limitations of this technology need to be carefully considered when designing courses for interactive video technology delivery.

METHODOLOGY

Participants were Aboriginal undergraduate nursing students from northern Manitoba program sites. A total of 16 students participated in two separate focus group interviews lasting 1.5 hours each. Interviews were audio-taped and transcribed verbatim. The use of focus group interviews is ideally suited for Aboriginal people as "attitudes and perceptions relating to concepts, products, services, or programs are developed in part by interaction with other people" (Krueger, 1994, p. 10). Findings of this study are presented as aggregated data to protect the anonymity of participants.

FINDINGS

There were four major themes identified: Learning the Rules; Student Interactivity; Creating a Positive Learning Environment; and Feelings of Cohesiveness. These will be discussed below.

Learning the Rules

This was the first distance learning experience for participants. They described the dissonance felt from being unaccustomed to the use of video conference equipment. As one participant stated:

> *We weren't sure when to speak out, how loud to talk, or when to ask a question. It was totally foreign to us.*

Until they learned the rules of classroom conduct, they felt "awkward and disoriented". Not knowing the rules of behavior contributed to long periods of silence in the Aboriginal student group.

Student Interactivity

The challenge for the teacher was to create a highly interactive learning environment in which it was safe for students to actively participate in classroom discussions. It was discovered that the remotely located students were highly interactive among themselves, particularly when their group was alone with the teacher or when they engaged in dialogue within their own small group.

Students valued the teacher being available "on air" for 10-15 minutes before and after each class. This served to create opportunities for teacher-student interactivity and was evaluated very positively by the Aboriginal students. As one participant stated:

> *I often times waited until after class to ask my questions of the teacher. Knowing he was available reduced my anxiety and helped me to concentrate while in class.*

Creating a Positive Learning Environment

All students were given a written exercise at the first class asking them to complete the sentence--*I learn best when...*The students consistently stated that they learned best when working in a group, when humor and fun were incorporated into learning and when they were visually stimulated.

Participants shared that it was "difficult for them to actively engage in classroom discussion as they were raised in an environment that did not encourage assertiveness or questioning". They felt intimidated by the assertive nature of the students at the main campus site. The teacher dealt with this by giving equal "air time" to the remote students. Simply asking: *Are there any comments from our colleagues in the North?* opened the door for dialogue.

Participants gained knowledge from the cooperative learning exercises used in class. These learning exercises included case study analysis through small group discussions. The teacher avoided the use of competitive strategies such as debate, as it would have placed the Aboriginal students at a disadvantage to the more verbal, assertive students from the main campus.

Feelings of Cohesiveness

A tendency to feel isolated was a common complaint of the participants. However, this study revealed that the interactive video technology format was well suited for Aboriginal students as they tend to have a preference for learning in groups rather than individually. They also have learning styles that show a preference for visual learning. An issue identified by the Aboriginal students was the lack of cohesiveness with students from the on-campus site. They reported feeling separated and left out and found it difficult to share feelings and experiences in the video conference format. Dickerson, et al (2000) describes this as being "on the fringe" (p. 194).

CONCLUSIONS

Despite some of the inevitable problems with video technology, students evaluated the learning experience in a positive manner. This study revealed a number of teaching strategies that were effective in addressing the unique needs of Aboriginal students learning at a distance. By attending to the unique world view of Aboriginal students, which are often in direct contrast to the academic culture of the university or college, teachers can create a positive learning experience for students and thus foster the ability to succeed.

REFERENCES

Bates, A. W. (2000). *Managing technological change: Strategies for college and university leaders*. San Francisco: Jossey-Bass.

Campbell, A. R., & Davis, S. M. (1996). Faculty commitment: Retaining minority nursing students in majority institutions. *Journal of Nursing Education, 35*(7), 298-303.

Chandler, G. E., & Hanrahan, P. (2000). Teaching using interactive video: Creating connections. *Journal of Nursing Education, 39*(2), 73-80.

Crow, K. (1993). Multiculturalism and pluralistic thought in nursing education: Native American world view and the nursing academic world view. *Journal of Nursing Education, 32*(5), 198-204.

Dickerson, S. S., Neary, M. A., & Hyche-Johnson, M. (2000). Native American graduate nursing students' learning experiences. *Journal of Nursing Scholarship, 32*(2), 189-196.

Hansen, D. G., & Irvin, S. D. (1996). Interactive video and female learning: Implications for a feminized profession. *Feminist Connections, 17*(2), 13-15.

Krueger, R. A. (1994). *Focus groups: A practical guide for applied research.* Thousand Oaks, CA: Sage.

LaSalle, I. (1996). Interactive television: Teaching and learning viewed through a feminist perspective. *Feminist Connections, 17*(2), 10-12.

Lipson, J. G., Dibble, S. L., & Minarik, P. A. (1996). *Culture and nursing care: A pocket guide.* San Francisco: University of California, San Francisco, Nursing Press.

MacIvor, M. (1995). Redefining science education for Aboriginal students. In M. Battiste & J. Barman (Eds.), *First Nations education in Canada: The circle unfolds* (pp. 73-98). Vancouver, CA: University of British Columbia Press.

USING IMMERSIVE VIRTUAL ENVIRONMENTS TO HUMANIZE THE LEARNING EXPERIENCE

Karen Casto
Western Washington University

INTRODUCTION

Immersive virtual environments humanize the learning experience by helping students forge connections with their course materials. These environments further strengthen connections by making the materials more relevant to learners' experiences, by providing them with opportunities for interaction and exploration, and by using multiple channels or modalities to reinforce and deepen learning. Research has shown that immersive virtual environments can improve learning, especially of complex concepts or constructs (Rose & Foreman, 1999; Salzman et al., 1999). When more than one brain pathway is stimulated, learning can be strengthened and improved (Walma van der Molen & van der Voort, 2000).

IMMERSIVE VIRTUAL ENVIRONMENTS

Educators have long used a variety of technologies to enhance their teaching. Photographs, drawings, sounds, movies, field trips, and models have all been used to illustrate complex concepts or demonstrate subject matter. For example, chemistry students might use a three-dimensional model of an atom to help them more easily envision its structure, or history students might attend a reenactment of a Civil War battle in order to more easily envision the complexities of historical events.

As computing technologies have become more powerful and efficient, they have often been used to create external representations of naturally occurring environments. The best of these representations allows the observer to interact with it in a natural manner (Loomis et al., 1999). As these representational systems, or "environments" become more realistic, students interacting with them become more immersed. Such immersion, or presence, as communication and computer scientists call it, allows for the suspension of belief that the surroundings are not real, and is more likely to occur when the environment is interactive and engages visual, auditory, and haptic perceptual systems (Nash et al., 2000).

According to Salzman et al. (1999), "By engaging users in learning activities, immersion may make important concepts and relationships more salient and memorable, helping users to build more accurate mental models." (p. 4) Immersive virtual environments can improve learning, especially of complex concepts (Nash et al., 2000).

Ivan Sutherland (1965) was the first to create an immersive virtual display on a computing platform. Since that first display, virtual environments have become more sophisticated and realistic. Some utilize a head-mounted display (HMD) in conjunction with a computer and head tracker. Others, known as CAVEs, involve a computer generating visual images onto the surfaces of a translucent cubical room. Shuttered glasses enable the person wandering through the room to experience the projections as solid 3D surfaces inside or outside the cube. Both of these technologies are quite expensive and immobile, requiring the user to go to the room or the equipment in order to experience the environment.

Virtual environments that involve a computer display only may be considered immersive or non-immersive. The sense of immersion or presence in these environments can be increased, however, by reducing the background environmental distractions, by making the virtual environment more engaging and interactive, and even by increasing the size of the video screen (Lombard et al., 2000; Rose & Foreman, 1999). These environments can be experienced anywhere, anytime, especially if they are designed to be viewed on the World Wide Web.

HUMANIZING THE LEARNING EXPERIENCE

The Center for Instructional Innovation at Western Washington University is dedicated to developing innovative projects that enhance instruction. As part of an initiative to use instructional technologies to humanize the learning experience, the Center for Instructional Innovation has sought ways to help students forge new connections with their instructors, with each other, or with their course materials (Casto & Brown, 2000). Students' connections with course materials can be strengthened by making the materials more relevant to their experiences, by providing opportunities for interaction and exploration, or by using multiple channels or modalities to reinforce and deepen learning.

Make the Subject More Relevant to the Learner's Experience

One of the first projects resulting from the humanizing initiative at Western Washington University grew from an Art History professor's wish to transport her students back in time and across the world to tour a medieval French village. The Center for Instructional Innovation determined that students could be more connected with their course materials by presenting these materials in a format familiar to the students. An open source project known as Genesis 3D (Eclipse Entertainment, 1998) was used to create a video game-like tour of a medieval French village (see Figure 1). Every attempt was made to create a virtual learning environment that was immersive by creating opportunities for students to become engaged and interact with the environment. Research has indicated that video games are engaging because they enhance the opportunities for those interacting with them to control the outcome of their exploration (Grodal, 2000).

Figure 1. Screen Capture from Virtual 3D Medieval Village Created at the Center for Instructional Innovation at Western Washington University.

The screen capture in Figure 1 is from the pilot virtual environment that was developed during the fall of 2000. Data from student evaluations of the medieval village will be collected and analyzed in early 2001. The Center

BEST COPY AVAILABLE

for Instructional Innovation envisions subsequent developments to this project, including adding people and objects to it and creating new virtual environments for a variety of subject areas.

Provide Opportunities for Interaction and Exploration

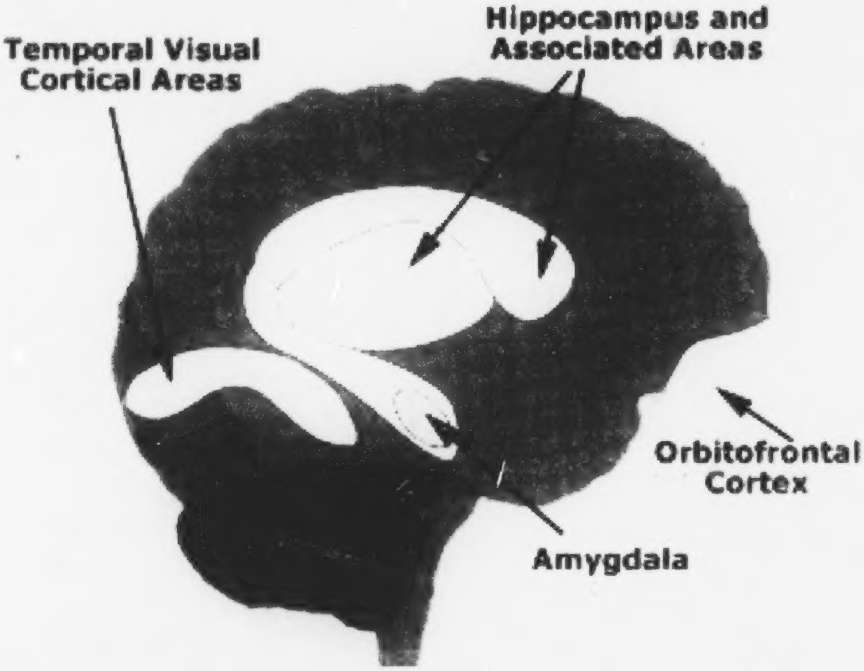
The Genesis 3D software engine provides its users with the opportunity to explore the medieval village environment created with it. Using the mouse and keyboard, students explored houses, went inside the central cathedral, and found other features within the environment, such as the town well and other common areas. Interesting features and viewpoints were built into the environment in an attempt to lengthen students' exploration time.

Use Multiple Channels To Reinforce And Deepen Learning

One of the major features of immersive virtual environments is that they simultaneously engage visual, auditory, and haptic perceptual systems. Psychological research suggests that using different perceptual systems and pathways actually improves recall of the material to be learned.

For example, research has shown that children remember more from children's news stories watched on television than from reading print versions of the same news stories (Walma van der Molen & van der Voort, 2000). Researchers theorize this is because of the dual-coding hypothesis (Paivio, 1969; 1971), which postulates that audiovisual information is stored in memory in two separate codes, one verbal and one visual, while text information is stored as a verbal code only. By using more than one channel to code information, people are more likely to recall the information. Research has also shown that there are separate memory systems in the brain used for storing different kinds of memories (see Figure 2) (Rolls, 2000). By tapping into more than one of these systems, learning can be reinforced and deepened. Immersive virtual environments, because they are engaging and interactive and because they can stimulate different pathways in the brain, are an emerging technology, useful for both research and instruction (Loomis, et al., 1999).

Figure 2. The Three Brain Pathways Involved in Different Types of Memory.


Temporal Visual Cortical Areas
Hippocampus and Associated Areas
Orbitofrontal Cortex
Amygdala

The first pathway, in the orbitofrontal cortex and amygdala, represents memories obtained while learning stimulus-reinforcer associations (rewards and punishers). The second pathway, involving the temporal visual cortical areas, is involved in learning invariant representations of objects.

BEST COPY AVAILABLE

The third system, which involves the hippocampus and associated areas, is implicated in episodic memory and in spatial function. Learning activities that are designed to use more than one of these systems may result in enhanced recall of the information to be learned. (After Rolls, 2000)

CONCLUSIONS AND RECOMMENDATIONS

The 3D virtual medieval village created by the Center for Instructional Innovation is one part of a larger institutional initiative to humanize the learning experience. This initiative assists learners to create connections among themselves, their instructors, each other, and their course materials.

Based on student evaluations from the Fall 2000 pilot virtual medieval village project, the Center for Instructional Innovation will further improve the design of the final version. The lessons learned will be used to increase the number of virtual worlds created to support instruction at Western Washington University. These environments will be freely licensed for use by any educational institution, and will be available as part of the Center for Instructional Innovation's Showcase Website (Center for Instructional Innovation, 2000), the next issue of which will be published in the spring of 2001.

REFERENCES

Casto, K., & Brown. J. (2000, November). *Humanizing the virtual education environment.* Paper presented at the 6th Annual meeting of the Asynchronous Learning Networks, College Park, MD.

Center for Instructional Innovation. (2000). *Innovative teaching showcase*. Bellingham, WA: Western Washington University. [On-line]. Available: http://pandora.cii.wwu.edu/showcase/

Eclipse Entertainment. (1998). *Genesis 3D open source project Website*. [On-line]. Available: http://www.genesis3d.com/

Grodal, T. (2000). Video games and the pleasures of control. In D. Zillmann & P. Vorderer (Eds.), *Media entertainment: The psychology of its appeal* (pp. 197-213). Mahwah, NJ: Lawrence Erlbaum.

Lombard, M., Reich. R. D., Grabe, M. E., Bracken, C. C., & Ditton, T. B. (2000). Presence and television: The role of screen size. *Human Communication Research, 26*(1), 75-98.

Loomis, J. M., Blascovich, J. J., & Beall, A. C. (1999). Immersive virtual environment technology as a basic research tool in psychology. *Behavior Research Methods, Instruments, & Computers, 31*, 557-564.

Nash, E. B., Edwards, G. W., Thompson, J. A., & Barfield, W. (2000). A review of presence and performance in virtual environments. *International Journal of Human-Computer Interaction, 12*(1), 1-41.

Paivio, A. (1969). Mental imagery in associative learning and memory. *Psychological Review, 61*, 179-211.

Paivio, A. (1971). *Imagery and verbal processes*. New York: Holt.

Rolls, E. T. (2000). Memory systems in the brain. *Annual Review of Psychology, 51*, 599-630.

Rose, D., & Foreman, N. (1999). Virtual reality. *The Psychologist, 12*(11), 550-554.

Salzman, M.C., Dede, C., Loftin, R.B., & Chen, J. (1999). A model for understanding how virtual reality aids complex conceptual learning. *Presence: Teleoperators and Virtual Environments, 8*(3), 293-316.

Sutherland, I. (1965). The ultimate display. *Proceedings of the International Federation of Information Processing Congress, 2*, 506-508.

Walma van der Molen, J. H., & van der Voort, T. H. A. (2000). The impact of television, print, and audio on children's recall of the news: A study of three alternative hypotheses for the dual-coding hypothesis. *Human Communication Research, 26*(1), 3-26.

IMPROVING PASS RATES IN MATHEMATICS USING INTERACTIVE COMPUTER SOFTWARE

Michelle R. DeDeo
University of North Florida

INTRODUCTION

A major challenge in any discipline is motivating students to actively engage in the learning process. In mathematics, students frequently possess phobias acquired from an unhappy experience with a mathematics teacher or learned from peers and parents. They also may resent the fact that they are required to take a mathematics class, and lament, "When will I ever use this again?" Thus, connecting with students in a positive manner is often difficult. So the questions faced by educators are two-fold: "How do I motivate my students" and "How do I help them learn?"

One trend in the past decade has been the rapid introduction of new instructional technologies. Jonassen (1996) made explicit connections between education and the uses of these new technologies, and Ebert-May et al. (1997), stated that learning could be more effective if active learning strategies are integrated into the curriculum. Implementation of these technologies, though, has typically not been as successful as hoped. Although students and educators may be receptive to new learning techniques, they can be stunned by the change from linear, traditional learning to interactive, digital learning.

A method of easing this transition is to implement technology in the classroom as an aid to the teaching process rather than as a replacement. In this way, students are eased into the technological environment and thus feel more comfortable learning in it. Also, the use of software that is individually paced and that can be used by the student at times convenient to them alleviates the embarrassment that students often face when asking questions in a large lecture and gives the student flexibility in the learning process. So the issue becomes to determine which type of technology is able to accomplish this feat and to decide on its use.

There are a number of programs from which educators can choose, and implementing a system is not a task to be taken lightly. At the University of North Florida (UNF) in Jacksonville, more than 1000 students enroll each year in college algebra to fulfill graduation requirements. The success rates in the traditional college algebra classes (grades of A, B, or C) over a period of years had hovered around 50%, which is unacceptably low.

It was determined by the mathematics faculty that technology that could be used to address this situation was available from Academic Systems™ (2000). Factors that influenced this decision were the success rate of the Academic Systems program at other institutions, the ability to tailor the software to meet the instructional needs of the faculty and its ease of use.

IMPLEMENTATION

After 3 years in the planning stage and nearly $100,000 dollars in the creation of a 40-seat college algebra lab and other expenses, 16 sections utilizing Academic Systems™ Interactive Mathematics were held in the 1999-2000 academic year. In the Fall 2000 term, 14 more sections of college algebra were implemented using this system. In addition to the traditional three hours per week of class time (two in lecture and one in recitation), an additional no-credit lab hour was scheduled for the students. These required laboratory sessions were monitored by teaching assistants.

The software is supported by Academic Systems' basic text materials and can be tailored for classes ranging from introductory intermediate algebra to college algebra. Content flexibility and comprehensive coverage, as well as an instructional support system that tracks and reports student progress, are crucial in the methods' overall success and the resulting success of the students.

EFFECTIVENESS

Student performance in 16 sections of College Algebra that used the software (Pilot Group) was compared with that of students in 13 sections that were taught in the traditional method (Control Group) during the 1999-2000 academic year. In the first weeks, the Pilot Group spent time learning the technology and the system as well as trying to learn the mathematics content. This resulted in significant frustration as the students overcame the initial learning curve associated with using new software and with system delays due to server problems. However, extra time in the lab fostered a camaraderie between students and confidence to keep going. By the end of the third week, most Pilot Group students had a firm grasp of the system's layout, its flaws and its nuances.

Two factors of success were measured in the college algebra classes: pass rate and retention rate. (At UNF, a withdrawal is considered a fail in terms of reporting success of the student). As evidenced by the pass and retention rates in Table 1, the overall success of the Pilot Group was significantly higher than the Control Group.

Table 1: Comparison of Success between the Pilot Group and Control Group

	Pilot Group N = [illegible]	Control Group N = 1040	Difference
Pass	96%	57%	12%
Withdraw	15%	21%	-6%
Fail	16%	22%	-6%
Ratio: Pass/No Pass	4.3 to 1	2.6 to 1	1.7 to 1

There are many facets of the software that seem to contribute to this success. First, the program integrates video, audio and interactive graphics to take the student through each problem in a step-by-step manner and presents the material in several different ways. This asynchronous learning environment slows the dynamic interaction and provides opportunity for reflection (Nulden & Hardless, 1999). The student's ability to see and hear also encourages them to become active learners. Students also benefit from the ability to choose activities they find helpful and to check their understanding with real-time feedback, something that is rare in the traditional classroom setting. In addition, they are given an almost unlimited amount of practice.

Since there is a goal at the end of each module (i.e., a quiz to be taken), students in the Pilot Group were compelled to complete each module within a designated time frame. This is in contrast to some students in the Control Group who would fall behind and stay behind throughout the semester.

CONCLUSIONS

The results of the quantitative data indicate that the mediated learning approach is successful in increasing pass rates in mathematics and may indeed offer at-risk students

BEST COPY AVAILABLE

a better chance to pass. It must be noted that the successes are not dependent on the technology itself, but in the ability to incorporate it into the learning environment.

The program is also economically worthwhile. These economic benefits include cost savings (students receive course materials and access to the software system at a price slightly lower than the cost of a standard algebra text), revenue generation (the cost of the course includes a few extra dollars to cover some of the cost of laboratory assistants during open lab hours), and non-cash economic value.

The initial costs are well worth the investment. Besides reducing the financial and mental costs students incur when repeating a course, the state benefits in not having to pay for a repeated course, the possible extra semester that a student may have to be enrolled, and the possible lost investment of a student who drops out (Academic Systems, 1999).

The next phase in the process is to experiment with eliminating the required lab hour, and to give the students the software to use at home. If successful, this will eliminate the cost of a Teaching Assistant for each mandatory lab hour per week and at the same time give the students the opportunity to work from home at any hour convenient to them. A foreseeable downside to this change would be a possible decrease in motivation resulting from losing part of the structure of the course. There are four sections in Fall 2000 and eight sections in Spring 2001 classes of this type. It is hoped that these classes will be as successful as the current ones.

REFERENCES

Academic Systems. (1999). The economics of mediated learning. *Interactive Mathematics,* [On-line]. Available: http://204.176.10.99/Interactive_Mathematics/Library/Mediated_Learning/Economics_Of_Mediated_Learning.asp

Academic Systems. (2000). [On-line]. Available: academicsystems.com

Ebert-May, D., Brewer, C. & Allred, S. (1997) Innovation in large lectures--teaching for active learning. *Bioscience, 47,* 601-607.

Jonassen, D. H. (1996) *Computers in the classroom: Mindtools for critical thinking.* Englewood Cliffs, NJ: Merrill/Prentice-Hall.

Nulden, U., & Hardless, C. (1999). Activity visualization and formative assessment in virtual learning environments. In J. A. Chambers (Ed.), *Selected Papers from the 10th International Conference on College Teaching and Learning* (pp. 117-125). Jacksonville, FL: Florida Community College at Jacksonville.

ENHANCING DISTANCE LEARNING WITH MULTIMEDIA: A WIN-WIN?

Timothy J. Ellis
Maxine S. Cohen
Nova Southeastern University

INTRODUCTION

Is multimedia a cost-effective enhancement to an online learning environment? Research in the field is mixed; literature both supporting and questioning the value of multimedia as an enhancement to learning is readily available.

The potential of multimedia as an enhancement to learning does have a theoretical foundation. Daniels (1994) summarized the theory of multi-channel communication in support of the potential for multimedia. According to this theory, humans have several channels by which data are communicated. If information is presented via two or more of these channels, there will be additional reinforcement and, consequently, greater retention, thereby improving learning.

Further support for the potential benefits of multimedia is offered by research in learning styles (Currie, 1995; McCarthy, 1997). A multimedia approach presents the potential to address the different approaches to learning evident among people (Riding & Grimley, 1999).

The efficacy of multimedia in education is not, however, universally acknowledged. Hall (1996) sounded a cautionary note regarding the incorporation of multimedia into the curriculum. The author highlighted some obvious dangers, including estimated cost, lack of trained personnel in developing multimedia titles and difficulty in and length of time required to develop training programs featuring multimedia. These concerns echoed similar studies by Solomon (1994) and Pruisner (1995) and very effectively summarized by Lookatch (1997). The effective and timely distribution of multimedia in an educational arena must also be considered (Parr & Curran, 2000).

One conclusion does seem safe regarding the potential value of multimedia in education: effectiveness is indeed relative. The learning environment, including the physical setting, the student-body composition, the background and perspective of the instructor, and the subject matter being taught appear to greatly impact the perceived value of the multimedia enhancements.

An online learning environment appears to be a setting in which multimedia enhancements could indeed provide noteworthy benefits to the learning process. As a form of distance learning, the online learning environment offers a rather barren environment featuring limited student-to-teacher and student-to-student interaction, limited lecture capabilities, and severely restricted presentation capacity.

DESCRIPTION OF THE STUDY

The study centered on a graduate course in multimedia systems. The importance of using multimedia to teach multimedia seems self-evident; it is important to "practice what we preach". The multimedia systems course described in this study was a cross-curriculum offering for Computer Information Systems, Information Systems, and Computing Technology in Education students.

The course was offered at the doctoral-level at Nova Southeastern University, School of Computer and Information Sciences, in a modified online format. Students met with faculty for twenty hours of instruction. The bulk of the course material was delivered via the Internet.

The student population of the School of Computer and Information Sciences is international, cross-cultural, and widely diverse in terms of educational and experiential background. Many of the students do not speak idiomatic American English. Access to online resources is limited and costly for parts of the student population. A significant portion of the student body is comprised of adult learners. Furthermore, the students presented a varied set of technical skills.

METHODOLOGY

This case study included five sections of the Multimedia Systems course offered during Winter/Spring 2000. The two instructors for the course identified three goals for the multimedia enhancements: 1) provide the students with a product that made the instructors appear to be more "real" and accessible; 2) serve as an example from which the students could model multimedia-enhanced products; and 3) offer a richer means of distributing supplemental readings.

The course instructors developed a CD featuring five media elements--video, audio, animation, interactivity, and text. During the development process the instructors kept a record of the time, hardware and software necessary, and distribution problems attendant with incorporation of each media element. To permit a basis of comparison, these qualitative data were then quantified using a five-point Likert scale.

Subsequent to the completion of the course, the students were asked to complete a brief questionnaire regarding the value of the CD. The questionnaire explored three areas: 1) the overall perceived value of the CD within the course structure; 2) the number of times each of the media elements were used by the student; and 3) the value of each of the elements in attaining the learning outcomes. To permit a comparison of costs to perceived values, the students used a five-point Likert scale.

FINDINGS

A total of 104 students completed the Multimedia Systems course during the period of this study; 53 completed the questionnaire, yielding a return percentage of 51%. The following sections discuss the results in terms of overall perceived value of the multimedia CD, the number of times each media element was used, and a cost-benefit profile of each media element.

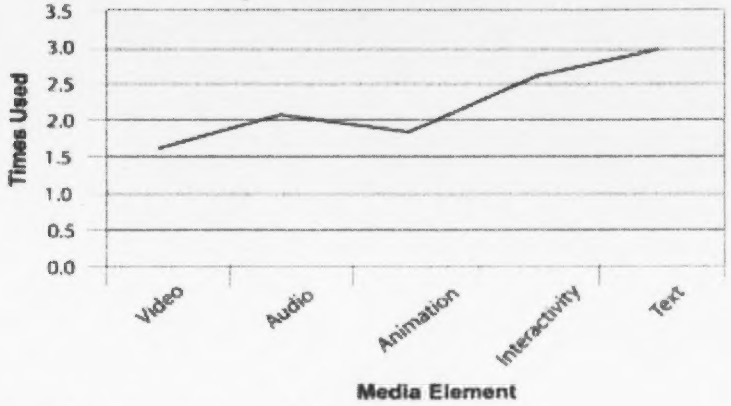
Overall Perceived Value

Two questions were directed at determining the perceived value of the multimedia CD: *Did this CD add value to your learning experience in this course? Should we continue to offer a CD of this nature as part of this course?* The responses on both questions were strongly favorable with 75% answering “yes” to the first and 83% “yes” to the second of the two questions.

Number of Times a Media Element Was Used

The questions regarding number of times each of the five media elements included in the CD were used offered six possible responses ranging from “Never” to “5 or More”. The average (mean) number of viewings of each element ranged from a low of 1.6 times for the video files to a high of 3 times for the text files. Figure 1 shows the means for all five elements.

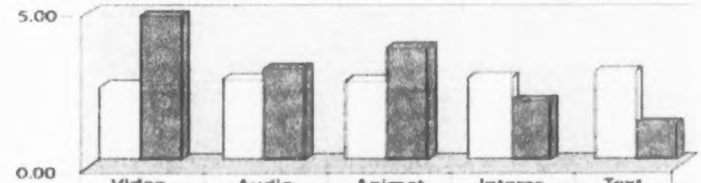
Figure 1. Average Number of Viewings by Media Element



Multimedia Cost-Benefit Profile

Seven learning outcomes were identified for the Multimedia Systems course. For each of the learning outcomes the student rated the impact of each of the media elements. Since the media elements were not learning outcome specific, the ratings for all seven learning outcomes were totaled by media element to obtain scaled scores of the effectiveness of each element in attaining course learning outcomes. The scaled scores were divided by seven to produce ratings based upon the original five-point scale. The instructors compared the scaled benefit scores with the cost rating assigned to the media element during the development process. Cost-benefit data are summarized in Figure 2 and presented in greater detail in Table 1.

Figure 2. Multimedia Cost Benefit Analysis



	Video	Audio	Animat	Interac	Text
☐ Benefit	2.78	2.81	2.80	2.95	3.00
▨ Cost	5.00	3.00	3.75	2.00	1.25

//

BEST COPY AVAILABLE

BEST COPY AVAILABLE

Table 1. Multimedia Cost Benefit Profile

Presumed Benefits	Associated Costs
Videos 1. Add greater depth and/or breadth to the material covered. 2. Provide a more positive, real connection between student and teacher in a distance environment. 3. Across the seven learning outcomes, the videos averaged a rating of 2.78, or slightly lower than neutral.	1. Preparing films locally is quite demanding terms of equipment, planning, scriptin rehearsal, and recording. Developing minutes of usable video required 2 professors devote over 20 hours each to scriptin rehearsal, and recording. 2. Editing locally prepared films is qui demanding in terms of equipment, software, a time. An additional 30 hours were required edit the raw footage into a set of usable vid files that could be incorporated into the onli class.
Audios 1. Direct attention and provide emphasis 2. Simulate classroom instruction 3. Promote greater student interest 4. In this study, audios fared no better than videos, receiving a rating of 2.81 across the seven learning outcomes	1. Sound effects are widely available in royalt free collections on either CDs or Web sites. in the case of animations, however, the sou effect can be quite distracting if not direct related to the content being presented. 2. Although sound file are not nearly as large video files, many of the production challenges equipment, planning, scripting, rehearsal, a recording – associated with video are equal applicable to sound.
Animations 1. Promote greater student interest. 2. Provide more meaningful illustration, especially of sequentially-structured information. 3. Provide full-motion graphics with significantly less overhead in terms of storage requirements than is necessary for video files. 4. Across the seven learning outcomes, the animations averaged a rating of 2.80, or slightly lower than neutral.	1. If commercially prepared animations are use the primary concern regards the applicability the material being presented. If the animati does not directly promote attainment of one more learning outcomes, it can, in fact, be qui distracting and counter-productive. 2. Development of local animations requir specific software and development effor Development of a 5 second animation requir in excess of 1 hour.
Interactivity 1. Actively involve the student in the learning process. 2. Promote greater student interest. 3. Student responses on the questionnaire indicated a more favorable view of the benefit of interactivity with a rating of 2.95.	Difficult to manage in terms of updating lin maintaining return paths, and eliminating 'de links'.
Test 1. Text is perhaps the most efficient method of communicating detailed information. 2. Student responses on the questionnaire indicated the most favorable reaction to the text element with a rating of 3.00.	The text file itself is quite easy to create, form produce, and distribute. Content is, of cour another matter entirely.

BEST COPY AVAILABLE

CONCLUSIONS AND RECOMMENDATIONS

The impact of a multimedia-enhanced product is not evident. When taken as a whole, the response to the product was strongly favorable. However, when examined in terms of facilitating attainment of learning outcomes, the response would indicate that the product had limited value. It is indeed unclear that a multimedia product can be evaluated by rating its separate components; the whole might indeed be greater than the sum of the parts in this instance.

Continued work in this area is indicated. Would a specific multimedia enhancement produce greater benefit if developed to support a specific learning outcome? Would multimedia enhancements show greater benefit in a different learning environment? Are there differential impacts of multimedia across learning styles, age, and gender?

REFERENCES

Currie, G. (1995). Learning theory and the design of training in a health authority. *Health Manpower Management, 21*(2),13-19.

Daniels, L. (1994). Audio vision: Audio-visual interaction in desktop multimedia. In D. G. Beauchamp, R. A. Braden, & R. E. Griffin (Eds.), *Imagery and visual literacy: Selected readings from the Annual Conference of the International Visual Literacy Association* (ERIC Document No. ED380056, pp. 57-63).

Hall, B. (1996). Easing into multimedia. *Training and Development, 50*(4), 61-62.

Lookatch, R. P. (1997). Multimedia improved learning – apples, oranges, and the type 1 error. *Contemporary Education, 68,* 110-113.

McCarthy, B. (1997). A tale of four learners: 4MAT's learning styles. *Educational Leadership, 54*(6), 46-52.

Parr, G., & Curran, K. (2000). A paradigm shift in the distribution of multimedia. *Communications of the ACM, 43*(6), 103-109.

Ruisner, P. (1995). *The role of color in remembering graphically presented information.* (ERIC Document Reproduction Service No. ED380073).

Riding, R., & Grimley, M. (1999). Cognitive style, gender and learning from multimedia materials in 11-year old children. *British Journal of Educational Technology, 30*(1), 43-56.

Solomon, M. B. (1994). What's wrong with multimedia in higher education? *T.H.E. Journal, 21*(7), 81-83.

COMMUNICATION TECHNOLOGIES AND INSTRUCTIONAL DESIGN

Michelle R. Howard-Vital
Joanne E. Nottingham
University of North Carolina at Wilmington

INTRODUCTION

John Seely Brown (2000), chief scientist at Xerox Corporation, has been expanding the realm of corporate research to include innovations in organizational and individual learning. His work includes various aspects of digital culture and adaptive systems of lifelong human learning. He indicates that communication technologies (such as computers, Internet, online courses, synchronous and asynchronous sources of information) are connecting us to the expertise of the faculty and to the expertise of what he terms, "the community mind". The community mind is comprised of a diverse group of persons with diverse perspectives and diverse levels of knowledge. The focus on diversity emphasizes the fact that individuals learn through dynamic dialogue. They share information, tell stories, critique each other and monitor the dialogue of others based on their cultural backgrounds and value systems.

The Internet furnishes opportunities for faculty to guide and provide feedback to students even when they are not in class. Students, some of whom, might be located in geographically different places, are learners who refine their views on an array of topics in a fluid environment. By observing the Internet-enabled community mind, we see new possibilities for the design of learning environments.

Solutions to problems or the development of new knowledge (e.g., a group of scientists or sociologists discussing cures or paradigms) commonly reflect conversations and collaborations from numerous individuals around the world. The global nature of these conversations and collaborations maximizes the benefits of the knowledge in ways that would be impossible without the communication technologies.

The authors believe that because of the current technology-driven world, it is essential for faculty in all disciplines to prepare students to interpret information and manage its meaning (Fairhurst & Sarr, 1996). Pre-college students spend an inordinate amount of time learning in social settings. For example, they learn how to use a Palm Pilot (computerized organizer) from a friend a mile away or a friend in another country. The value of this type of social learning should not be underestimated in the Internet Age.

Social learning involves a great deal of exchange, discussion, interpretation, and critique of information and can be viewed in chat rooms and discussion forums for online courses. Some community knowledge is disseminated in the form of articles or e-books; other community knowledge exists on the Internet and is updated rapidly from numerous learners around the world, as they attempt to manage its meaning. Transmission of information by the Internet expands the "classroom" or learning environment of students. So, as faculty offer examples of desirable outcomes, faculty should also demonstrate analytical tools for understanding and interpreting multiple and complex forms of information.

GUIDING UNDERGRADUATE STUDENTS

One author's recent teaching of prospective teachers to design effective, instructional environments has underscored the importance of planning learning environments. The other author's recent teaching of leadership skills to communication studies undergraduates has emphasized the importance of managing meaning when communicating information to others. These experiences have rekindled thinking about the ultimate outcomes of the teaching and learning processes.

The authors affirm that, ultimately, instruction should be designed so students understand the learning process and determine for themselves how to learn best. It is assumed that most students will experiment with numerous learning strategies and tools such as computers, e-books, Web sites, traditional books, CD-ROM's, and multi-media presentations. "Successful: students would demonstrate they have "learned" and also acknowledge the processes of research, critique, association of new information with previous knowledge, and creation of new ideas. Guiding individuals as they enhance their learning and communication strategies becomes an important focus of teaching.

THEORIES

Current and future communication technologies offer a host of options for constructing a multi-sensory learning environment for students that parallels their non-school lifestyles and learning experiences. Gagne & Driscoll (1988) state that we cannot insure that students have learned anything unless: 1) the instruction takes into consideration the learning process of the brain; 2) the conditions designed to guide the students are designed to improve the learning of specific skills (intellectual, motor skills, etc.); and 3) students are able to demonstrate their learning consistently. Communication technologies can be employed to support the learning of specific domains of learning and assist students as they develop proficiency in learning.

Framing

Fairhurst & Sarr (1996) offer a theory about the importance of managing the meaning of information that seems essential to consider in a world replete with communication technologies. They argue that a leader must manage meaning effectively, and faculty are leaders.

The communication of information, according to Fairhurst & Sarr (1996), is a central function of leadership and learning to become a more effective leader means learning to communicate information in an effective manner. This management of meaning is called "framing". When a leader communicates, s/he "frames" information, s/he chooses a specific interpretation over another and thus manages the meaning.

Framing begins with the establishment of mental models, or "deeply held internal images of how the world works" (Fairhurst & Sarr, 1996, p. 24). The acceptance of mental models is essential in the understanding of framing. In school and in the world of work, there are numerous mental models that relate to specific communication contexts. Even though it is not as apparent to some because of the nature of the Internet, meaning is constantly being managed through the information transmitted by the Internet. Fairhurst and Sarr (1996) affirm that "...powerful framing in action: 1) increases the chances of achieving communication goals; 2) requires initiative; 3) is for everyone; and 4) provides opportunities everywhere." (pp. 11-19).

In order for students to be successful in framing information, they must define the goals of their communication and narrow the set of possible meanings that pave the way towards a more direct path to goal achievement. The establishment of communication goals seems to be crucial when employing a variety of communication technologies and when communicating through the Internet. Diverse goals in communication often result in the dynamic dialogue characteristic of the "community mind".

Variance in Pace and Time

In addition to assisting students as they manage the meaning of information, faculty should also realize that communication technologies allow for variance in time required to learn content. Benjamin Bloom's (1981) concept that faculty should teach, test, and re-teach until nearly all students have achieved mastery of the content seems to "make sense," even though it contradicts the experiences of many university students.

There are numerous examples of mastery learning in the entertainment game world where a player proceeds at his/her own pace and cannot continue to the next level until he/she has mastered the challenges or skills of the current level. Communication technologies provide numerous instructional options for faculty to individualize learning by varying the pace and time of learning for individual students. We believe that this will make learning more satisfying for students and promote lifelong learning.

We recently observed several eleven-year old, sixth grade students learning grammar via an interactive CD-ROM. After "playing" with the CD-ROM for 30 minutes, they proclaimed that grammar was "fun." The colorful quick moving graphics that resembled a video helped students to focus. Additionally, the immediate and consistent feedback from the interactive computer program minimized frustration, reinforced learning, kept students engaged and assisted them in processing the information.

College students often seize the opportunity to advise that there are still faculty who present the content in a lecture format and measure students' proficiency in learning in competitive paper and pencil formats. Students then move on to cover more content which is sequentially linked to the earlier content that they did not master. The focus of this type of instructional design maintains constancy of time and place for all students. The instructional design is also constant and does not allow for variations in students' learning styles or interests. This type of "teaching" appears to override concerns about whether individual students have mastered the content.

Essentials for Innovation

As stated previously, the ability to make sense of information, consider it from diverse perspectives, interpret it to others, utilize it, manage its meaning, and evaluate its overall usefulness and accuracy will be important in an information congested world. Increased interconnections of communication technologies and collaborations among different fields of knowledge, and among those of different backgrounds continue to be essential to innovation.

To achieve success, students will be compelled to demonstrate what Bloom terms as higher-level cognitive thinking skills. These skills include analysis (taking complex ideas apart and understanding their relationships), synthesis (putting items together and constructing a new whole), and evaluation (judging the value of information) (Woolfolk, 1998). Additionally, the student can enhance his or her communication of information by employing some of the tenets of framing: interpreting and evaluating the context of the situation, cultivating the context, recognizing the constraints of the context, and finally, learning how to impact the flow of communication of information (Fairhurst & Sarr, 1996).

THE ULTIMATE GOAL OF INSTRUCTION

The authors believe that the ultimate goal of all instruction is to develop independent learners who demonstrate higher-level cognitive thinking skills and effective communication skills. These learners would have the ability to employ a variety of tools to enhance their learning. The tools also provide them with the means to demonstrate leadership in an information-laden world.

Tools for the management of meaning are called miracle questions, exception framing, and continuous benchmarking (Fairhurst & Sarr, 1996). Miracle questions help in the definition of goals and the discovery of hypothetical solutions to problems. Exception framing is the ability to use language, thought, and forethought in the search for exceptions to problem behavior and allow for appropriate and useful mental models to be formed. Continuous benchmarking is the development of mental models as a continuous process in which the learner looks at where he or she is and where he or she wants to be. As a result, the learner contrasts current circumstances with his or her vision.

Faculty who teach undergraduates are faced with the probability that the use of communication technologies will increase in their educational institutions as well as society as a whole. Faculty therefore need to assist students in learning how to understand context sensitivity and recognize opportunities and constraints when communicating information. Fairhurst & Sarr (1996) explain context to include how people think and what people expect. Thus, the student must examine the contextual influences of the frame to better understand the culture and cultural norms of the situation or environment. This point seems extremely important when communicating in person or on the Internet.

Communication faculty are not the only ones who employ tools for communicating information. Other disciplines use tools that include metaphors, jargon, contrast, spin (putting a subject in a positive or negative light) and storytelling. It is likely that the average new faculty member will be expected to guide the learning of students by combining communication tools with communication technologies.

Faculty in all disciplines need to understand the learning process and how various communication technologies can present their academic content in formats that correlate to the learning styles and interests of students. Learning environments are no longer finite environments in which the teacher closes the door and controls the flow of information. Ideally, students' level of mastery should determine where they fit in an educational continuum.

Since it is no longer as necessary for faculty to be the sole source of knowledge or content for students, it is the responsibility of faculty to focus on the learning process. Students, on the other hand, need to be prepared with tools to interpret and manage the meaning of enormous amounts of information and opportunities for communication. For both faculty and students, communication technologies (distance learning, e-mail, streaming video, and online discussion groups) can be employed to provide interactions with a plethora of "experts" on any given subject. Faculty can also employ a range of communication technologies to help students discover how they learn best.

In addition to video clips, graphics, and simulations, some of the anywhere/anytime learning technologies allow students to vary their learning paces and monitor their progress. Do Internet video clips assist students develop specific intellectual skills? What enhancements can I bring to the classroom to help students make associations that will help them encode and analyze information? These questions are examples of how faculty can measure the relationship between specific communication technologies and specific learning outcomes. When teaching becomes more synonymous with effective learning and effective communication, the focus shifts to the outcomes of the learning experience and the student. It is hoped that with the appropriate communication tools, faculty will construct learning contexts that appeal to the learning styles and interests of students of this century.

CONCLUSIONS

The ability to deliver content in a multi-sensory, interactive format to a fluid community of learners changes the teaching and learning environment, the roles of the faculty and student in the learning and assessment processes, and, in some cases, who offers educational programs. Outcomes in students' learning should reflect the advancements in communication technologies and what is known about the learning and communication processes. The steady rise of corporate universities also results in the need for all institutions of higher education to reexamine the essentials of teaching and learning processes. The findings of these analyses should be reflected in the enhanced learning environment of students.

REFERENCES

Bloom, B. (1981). *All our children learning*. New York: McGraw-Hill.

Brown, J. S. (2000). Growing up digital: How the Web changes work, education, and the ways people learn. *Change, 32* , 11-20.

Fairhurst, G. T., & Sarr, R. (1996). *The art of framing: Managing the language of leadership.* San Francisco, Jossey-Bass.

Gagne, R. G., & Driscoll, M. (1988). *Essentials of learning for instruction* (2nd ed.). Englewood Cliffs, NJ: Prentice Hall.

Woolfolk, A. (1998). *Educational psychology.* Boston: Allyn & Bacon.

PROBLEM-SOLVING BASED COMPUTER USE COURSE FOR NON-MAJORS

William J. Joel
Western Connecticut State University

INTRODUCTION

When computer classes were first introduced into college curricula they often took the form of programming classes, using languages such as BASIC or Pascal. The intent was for students to gain exposure to the logical nature of computers. The main difficulty with this approach was that for most students programming was a skill they would not necessarily utilize in their other courses. Soon, the advent of office automation software (word processing, spreadsheets, etc.) changed this scenario. This change in computer use brought about a shift in what non-majors were presented with in an introductory computer class.

This paradigm shift produced courses that fell under the general subject heading of "computer literacy" and assumed that what students needed to be successful computer users was a firm grasp of the terminology pf computer technologies, as well as a mechanical understanding of how to use these applications. Though students do need to be versed in the "language" of computers (as opposed to computer languages), and how to use these programs, this approach did not truly address the computing needs of non-majors.

Computer literacy courses did provide students with a basic understanding of what office automation software did, but what this family of courses lacked was an exploration of *how* and *why* to use these applications.

The word *how* is used here not in a simple, mechanical manner, but rather in a broader problem-solving context. For example, to be a competent user of a hammer, one needs to know more than simply that when you strike a nail with a hammer, it will more than likely be driven into a piece of wood. In order to be competent, one should understand not only something about the mechanics of how a hammer works, but also when to use a hammer, or perhaps when another tool would be more appropriate.

What is missing from both of these approaches to non-major computer courses is an exploration of those problem-solving strategies and tools that lend themselves to production of computer-based solutions (Boser, 1993). Specifically, by introducing students to various types of models, they can become not only computer literate but also computer savvy.

COURSE OVERVIEW

What follows is a discussion of experiences and observations based on courses taught at Marist College (Poughkeepsie, NY), and The Culinary Institute of America (Hyde Park, NY). These courses consisted of seven topics: 1) Computer Terminology; 2) Problem-Solving; 3) Modelling; 4) Word Processing; 5)Electronic Spreadsheets; 6) Databases; and 7) Graphics Design.

Computer Terminology

In this portion of the course, students are introduced to the lexicon of computers in much the same manner as in more traditional computer literacy courses. Students are presented with a brief history of computer technologies, interwoven with terms and concepts relating to computer hardware and software. Though problem solving is the basis for this course, it is still important that students be able to use the proper terms when discussing computer use. More importantly, given that most other computer texts students will read--such as software manuals--are based on this same terminology, it is imperative that students be able to "talk the talk" as well as "walk the walk."

Problem-Solving

Given the ability for students to use computer applications in a non-linear fashion to produce solutions to problems, students often use ad-hoc approaches to solution production. They tend to "hack" at the problem until they find an answer. "Hacking," with respect to computer use, means to develop solutions in an ad-hoc manner, as opposed to a structured approach. Though students who use this approach do produce solutions that are appropriate, they often find it hard to discuss how they came up with their results. This is similar to preparing a meal by adding a "little of this and a little of that" without writing down either the method or the ingredients. The ability to duplicate results is never a given.

In this course, students are presented with a three-phase approach to problem solving that forces them to think first and then do. The three phases are titled *Know*, *Need* and *Do*.

The Know Phase. During the Know Phase, students need to determine what they already know from the initial problem statement. They should avoid any actions that could be viewed as actual steps in a solution. For example, consider the following problem:

> *You have been asked to purchase five pounds of apples at fifty cents per pound.*

> *You are given a ten-dollar bill. How much change will you have after your purchase?*

What students would know from this problem is the quantity of apples they are to buy, the unit cost for apples and the amount of money they are initially given. What students do not know from the problem statement is either the total cost of the apples or their subsequent change. Unfortunately, most students would quickly begin forming partial solutions before having all the facts. This is true not only for simple problems, such as the apples problem, but also for more complex problems. If students do not understand sufficiently what is known before continuing, inappropriate solutions are often produced.

The Need Phase. In this phase, students begin to construct their solutions, determining what steps and strategies to include in their solution method. For example, it might be appropriate to state that in order to determine the change returned one would need to compute the total cost for the apples. During this phase, students should also determine what strategies or facts they do not know, and attempt to locate them. What students still should not attempt is to execute any of the steps in their method. By placing this last restriction on student actions, it can be ensured that students will focus on the process of creating a solution method and not on the end result.

The Do Phase. This is where students can now execute their solution to obtain an answer and then check their answer to verify it is correct. With respect to computer-based problem solving, this is the phase during which students must use computers. Note that it may also be appropriate to use computers in the previous two phases as well, but to do so might foster ad-hoc solutions, which are to be avoided.

This is similar to the four-phase approach recommended by the MathCounts foundation (MathCounts, 1999), based on the NCTM Curriculum and Evaluation Standards for School Mathematics. In that instance, the four phases included: *Find Out, Choose a Strategy, Solve It,* and *Look Back.* The first of two steps correspond to the *Know* and *Need* phases in this author's approach, while the last two steps correspond to the *Do* phase.

Modeling

During their introduction to problem solving in general, as well as subsequent explorations of office automation software, students are presented with various modeling techniques that can be used to represent all phases of the problem solving process. By definition, a model is a useful representation. A model is something that contains key elements of the object being modeled, but not all elements, and as such represents the object. Given that it can be used to facilitate solution production, it is also useful. Further discussion of specific models will be included in the discussion, below, of each application area.

Word Processing

Word processing is perhaps the simplest application for students to master. Therefore, the question arises as to what sort of model would be beneficial for students, and why should it be introduced. The answer to the latter part of this question rests in an earlier statement, that computer use can foster a non-linear approach to problem solving.

Consider how easy it is, relatively, to produce multiple versions of a document using the software tools available to students. Not only can students produce one version from another, they can also combine elements from several different versions to create yet another. This non-linearity can be both a benefit and a hindrance to efficient computer use.

A more effective approach is to first plan what is to be written and then compose the document. This does not imply that the entire document should be written by hand, or that computers should only be used once a student is prepared to write the final copy. On the contrary, a word processing application can be used at all stages of this process.

What students are encouraged to do first is to prepare a model of their final document, choosing among such tools as outlines, concept maps (Mind tools--information skills--concept maps,1998; Trochim, 1999), flowcharts, etc. each of these modeling strategies can help students to organize their thoughts before they begin to compose their work. Also, students are instructed to limit the number of formatting choices they make before they have completed writing and editing their document. Word processors are excellent tools creating visually appealing documents, but as any chef knows, even the best presentation cannot save a poor meal.

This method of insisting that students compose their documents first before dealing with formatting issues reinforces a multiple-phase approach to problem solving. It also aids in slowing students down in their pursuit of a finished product. Students are forced to focus on process, thinking through a problem solution before implementing it.

Electronic Spreadsheets

While teaching this course over the years, it has become readily apparent that what students have difficulty with regarding electronic spreadsheets is not necessarily the software itself, but rather how to craft a numerical solution to a problem. If a student does not know how to solve a problem mathematically, what chance does s/he have in representing this solution as a spreadsheet?

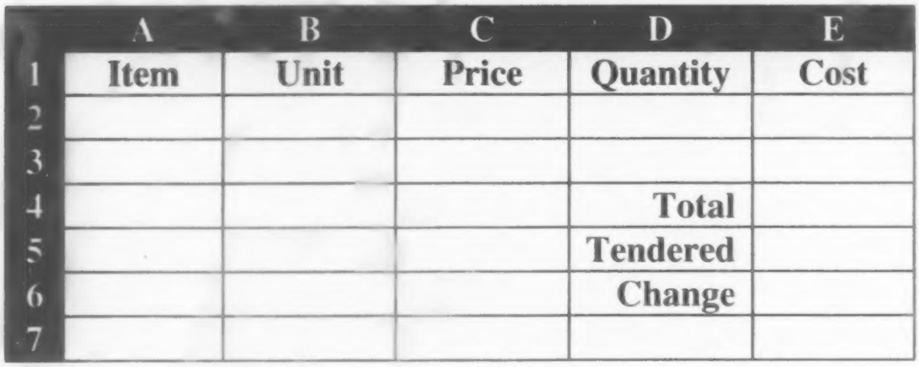
Therefore, students in this course are encouraged to first cast their solutions as sets of equations where each equation represents the method for computing the value of an unknown identified in the Need Phase. Continuing with our apple-buying example, a student might produce the following.

$$Cost = Pounds \times Price$$
$$Change = Amount - Cost$$

Note how variable identifiers are complete words (or phrases) as opposed to more cryptic names such as "C" for cost or "A" for amount. (Or even worse, "A1", "A2", "A3", etc.) It is at this stage that students are encouraged to "look up" those formulae they do not yet know, with the understanding that effective problem solving is not necessarily "knowing it all," but rather knowing how to properly form a question and perhaps where to look for answers.

After a set of equations has been generated, students now create a layout for their solution using a standard electronic spreadsheet application.

Figure 1: Sample Spreadsheet Layout



	A	B	C	D	E
1	**Item**	**Unit**	**Price**	**Quantity**	**Cost**
2					
3					
4				**Total**	
5				**Tendered**	
6				**Change**	
7					

Each initial known and unknown value is assigned a cell in a worksheet. The value for each unknown cell will be a spreadsheet formula derived from its corresponding equation. Upon finishing their layouts, students can now rename their variables using the names of the cells assigned to known and unknown values. In our example, Pounds becomes D2, Price becomes C2, Cost becomes E2, Amount becomes E5, and Change becomes E6. In addition, Total has been added in E4. This approach reinforces the concept that simply renaming a variable does not change the final outcome.

$$E2 = D2 \; x \; C2$$
$$E6 = E5 - E2$$
$$E4 = SUM\,(E2{:}E3)$$

Lastly, the expression to the right of each equal sign in our renamed equations, now represents the formula to be placed in the cell whose label is to the left of the equal sign.

Databases

With respect to databases, students are shown how a database is a model for a collection of objects, where each record in the database is a model for an object in the corresponding collection. This modeling approach to databases is similar to the object-oriented approach in programming. Using this approach, students can be presented with the essential elements of relational databases without the need for a more detailed exploration.

For example, consider the task of modeling student course transcripts. Each student has attributes such as name, address, phone number, courses taken and their associated grades. Each course has a course number, title and instructor. Each instructor has a name, department, and rank.

In this simple example, we've already introduced three data files and the relationships among records in all three. In addition, we could now discuss the difference between a system view (model) of the data and a user view. Besides a scheme for organizing the data in a database based on system requirements, there may be a second scheme for inputting and displaying this data based on how the user views data relationships.

The development of search queries, or questions asked of a database, represents a task incorporating logic and an understanding of how data are organized in a database. SQL (Structured Query Language) (Hoffman, 2000), a language often used to create queries, is a language based on relational algebra. In addition, it includes many of the concepts found in any programming language. By presenting students with exercises that require the construction of queries based on SQL, students are introduced to the intricacies of programming without the necessity of learning a full, general-purpose programming language.

Graphics Design

Graphics Design is perhaps the easiest topic to associate with modeling. Consider the example of a road map. A road map is not the actual road system one might plan to drive on, but it does include those road attributes (name, location, type, path, etc.) that are important for travel planning. Various software applications can be used to introduce graphics design to students including paint, drafting, and design softwares.

OBSERVATIONS

In teaching this course, it became readily apparent that what students needed to do was threefold. First, students needed to slow down. As stated above, the ability to act in a non-linear fashion is perhaps a drawback of computer applications. Students needed to be constantly reminded of the three phases of problem solving, to the point where assignments were written such that students were required to proceed through the stages in order.

Second, students needed to see that they were capable of mastering computer use, even if they had little or no prior computer experience. In today's classroom, this is becoming less of an issue, while the former concern of slowing students down is becoming more imperative.

Lastly, students need to understand what a given application can do, and perhaps why, but definitely not how. Too often, a student would ask why they could not do something, whereas the more appropriate choice would be to first identify a desired outcome and then determine what to do based on the functionality of a given application. A related lesson to be learned is how to determine which type of program to use for a given problem. Also, assuming students are encouraged to "chunk down" a problem into smaller, more manageable parts, they should also learn how to choose a program for a given sub-problem.

CONCLUSIONS

As computer technology becomes an even greater part of a student's everyday life than it already is, it becomes important to provide non-major students with an introductory course in computer use that focuses on the effective and efficient use of computer technologies, as opposed to either simply learning the terminology or which menu item to click on. Such is the difference between cooks and chefs.

By introducing students to a variety of software applications that demonstrate key aspects of computer-based problem solving, focusing on the problem solving skills needed to use these tools and not the tools themselves, faculty can insure that students will not only be able to use these tools but also any additional software applications they might encounter.

REFERENCES

Boser, R. A.. (1993). The development of problem solving capabilities in pre-service technology teacher education. *Journal of Technology Education, 4*(2). [Online]. Available: http://borg.lib.vt.edu/ejournals/JTE/jte-v4n2/boser.jte-v4n2.html

Hoffman, J. (2000). *Introduction to structured query language.* [Online]. Available: http://w3.one.net/~jhoffman/sqltut.htm

MathCounts Foundation. (1999). *Problem solving strategies.* [Online]. Available: http://www.mathcounts.org/Problems/strategies.html

Mind tools--information skills--concept maps. (1998). [Online]. Available: http://www.mindtools.com/mindmaps.html

Trochim, W. M. K. (1999). *Concept mapping: Soft science or hard art?.* [Online]. Available: http://www.conceptsystems.com/papers/publications/epp2/epp2.htm

Urban-Lurain, M., & Weinshank, D. J. (1999). I do and I understand: Mastery model learning for a large non-major course. *SIGCSE Bulletin, 31*(1), 150-154.

WHYS AND HOWS OF TEACHING EFFECTIVELY VIA INTERACTIVE DISTANCE LEARNING

Jo Jones
Linda Kutilek
Warren Flood
Nikki Conklin
The Ohio State University

INTRODUCTION

To remain viable in today's high tech informational society, formal and non-formal teaching in higher education must incorporate computer-based instruction. Educators must keep up with the technological revolution that has restructured how people access knowledge.

Teaching effectiveness and instructional strategies take on new dimensions when teaching via distance education methods. Those who are comfortable teaching in face-to-face environments are facing challenges requiring new approaches to teaching and learning. Teaching strategies highly effective in group settings may not enhance learning when the learner is sitting in front of a computer in the comfort of his/her home or office.

The Extension Employee Development Network at The Ohio State University provides training for employees in effective teaching. In addition, it provides support for aspects of undergraduate/graduate classes on teaching strategies, adult learners, and incorporating critical thinking into learning environments. The Network has traditionally taught effective teaching courses/modules in face-to-face group settings. Four members of the Network decided the time had come to revamp this teaching experience in alignment with high tech teaching strategies.

A multi-faceted approach was used in the development of this individualized "effective teaching experience". The experience was designed to include a computer-based training/teaching module (Web-based or a CD), on-line learning partners, concept integration through teaching and facilitated learning, coaching and observation, and advanced training and in-service offerings. The experientially-based multimedia resource CD included video references, text information, hyper-linked text, video/text/audio examples of implementation methods, pretest/posttest evaluation instruments, comparison log template and application exercises.

The remainder of this paper addresses learning theories and principles related to computer-based training, instructional design and experiential learning which formed the bases for the authors' approach to the design of the new teaching experience. The quality of teaching and learning must not be compromised when using computer-based training. Teaching and learning principles and theories are just as critical in high tech dissemination of information as it is in high touch learning environments.

The authors have focused on "constructivist learning theory" as a theory appropriate for guiding instructional design projects that are computer-based. According to Bencze (1999) constructivism emphasizes the mental building learners seem to do when they learn. The theory relates to the gestalt way of thinking that the whole is more that the sum of its parts. In the field of management this idea is referred to as synergism. Learning, from the bringing together of various input from different parts of our lives, suggests the need for active versus passive learning.

The authors have developed an operational definition of constructivism, as follows:

> *...a philosophy of learning that subscribes to providing learners with active learning processes that provide experiences, collaborative activities, shared discourse and reflection that encourages the learner to assemble, build and/or construct their own and a shared knowledge base. Thus, the learner is provided with an opportunity to take the knowledge gained through these active learning processes and extend it beyond what was presented.*

Following are critical instructional design principles that support a constructivist learning theory. These principles were adapted from Rosenburg (2000).

> Educational goals must motivate and compel the learner.
>
> Program activities/exercises must focus on learning by doing.
>
> Learners perceive the educational environment as one in which it is safe to fail.
>
> Coaching and feedback strategies are critical components.
>
> Examples of modeling by experts are provided as part of the experience.
>
> Authentic case studies and scenarios are furnished for a realistic perspective.

> Product affords opportunities to apply/reuse information after learning occurs.
>
> Interacting with the program sets the stage for the learner to bridge "real life" experiences with the learning.

Experiential learning theory is compatible with active learning and constructivism. Kolb's(1984) four components of experiential learning include:

> Concrete experiences including sensing and feeling.
>
> Reflective observation also referred to as watching.
>
> Abstract conceptualization involving thinking.
>
> Active experimentation or stated also as doing.

Whether teaching credit courses, providing inservice training for extension faculty who teach community-based non-formal courses, or conducting effective teaching workshops for college professors or graduate teaching assistants, faculty must be on the cutting edge of technology. With every passing year many learners arrive with more and more high tech literacy. The younger generations in the workforce are described as "cyber literate" and "techno savvy" (Salopek, 2000). Training programs and learning experiences must catch the attention of those who grew up with the glitz and glamour of videos, MTV, computer games, and learning from high tech/interactive toys.

The higher education students/learners of the future who will have entirely grown up in the digital age will have a tremendous edge on information technology. Alch (2000) in reference to the net generation said "they're comfortable with changes brought about by new technologies and e-commerce...they're conversant with a communications revolution transforming...education...and every other institution" (p.32). *Are teachers of higher education ready to teach this new generation?*

Dunerstadt(1999) would say that if we are not ready we better get ready. In Katz's book *Dancing with the Devil*, Dunerstadt says:

> The classroom itself may soon be replaced by more appropriate and efficient learning experiences. Indeed, such a paradigm shift may be forced on faculty by the students themselves. Today's students are members of the "digital generation." They have spent their early lives surrounded by robust, visual, electronic media...Unlike those of us who were raised in an era of passive, broadcast media such as radio and television, today's students expect--indeed demand--interaction. They approach learning as a "plug-and-play" experience... inclined to plunge in and learn through participation and experimentation. Although this type of learning is far different from the sequential, pyramidal approach of traditional college or university curriculum, it may be far more effective for this generation, particularly when provided through a media-rich environment (p. 12).

One of the side benefits from the creation of the computer based program on effective teaching is knowledge gained relating to the "how to's" of designing educational experiences that are computer- or Web-based. The authors offer the following advice to other educators who are ready to accept the challenge of designing a computer-enhanced learning experience:

> Make it a team effort that brings together expertise in the subject matter being taught, expertise in educational design and expertise in computer-based programming. If any of the three areas of expertise is missing, the quality of the end product will be compromised.
>
> Learn from others' experiences by accessing other educational computer programs. Try out the activities and make a list of the techniques/strategies you like and dislike. Have colleagues interact with the program and make a list. Compare the lists of likes/dislikes and then decide which would be appropriate for your project.
>
> Engage the assistance of a "sounding board" comprised of people who are representative of the end users. Have them continuously interact with the evolving program and give feedback as a type of formative evaluation.
>
> Include a variety of learning activities that meet the various needs of your learners. Ask yourself if the training is tailored to different learning styles, or are you trying to make one size fit all (Goldberg, cited by Salopek, 2000)

Stonecipher (2000) poses the question and answers it--"will the introduction of new technology present any threat to traditionalists? Of course it will...we need to make sure that we are on the winning side of new technologies" (p. 3).

Many in higher education are indeed traditionalists. Some educators will feel threatened but many will rise to the challenge of integrating new technology strategies with their current teaching methods. For those who do not rise to the challenge, they may retire from the "ivory tower," never having: 1) provided feedback to a student via e-mail; 2) given a grade to a graduate student they have never met; or 3) engaged in a debate through a chat room with students from nine states and four countries. The time is right for experimenting with high tech strategies in interacting with learners. Higher education must rise to the occasion.

REFERENCES

Alch, M. L. (2000). Get ready for the net generation. *Training & Development, 54* (2), 32-34.

Bencze, J. L. (1999). *On-site science curriculum resources: Constructivism.* [On-line]. Available: http://www.oise.utoronto.ca/~1bencze/Constructivism.htlm

Dunerstadt, J. J. (1999). Can colleges and universities survive in the information age? In R. N. Katz & Assoc. (Eds.), *Dancing with the devil: Information technology and the new competition in higher education* (pp.1-25). San Francisco, CA: Jossey-Bass.

Kolb, D. (1984). *Experiential learning: Experience as the source of learning and development.* Englewood Cliff, New Jersey: Prentice Hall.

Rosenburg, M. (2000). *Ten steps to building a digital learning strategy.* Presented at American Society for Training and Development 22nd Annual Conference & Exposition - Interactive Multimedia 2000, Kissimmee, FL.

Salopek, J. J. (2000). The young and the rest of us. *Training & Development, 54*(2), 26-30.

Stonecipher, H. C. (2000). Faster, better, cheaper. *Executive Excellence, 17*(10), 3.

BORROWERS AND THIEVES[1]:

INTERNET PLAGIARISM

Kathleen King
Idaho State University

INTRODUCTION

A Short History Of Borrowing

Today plagiarism is a serious offense, but borrowing has not always been thought of as wrong. The ancient Greeks praised "imitation of…superior models" while encouraging "the imitator" [to] "make a contribution of his own" (Lindey, 1952, p. 66). Monks laboriously copied medieval manuscripts, and itinerant musicians of the Renaissance passed ballads from one to the other. Dante borrowed myths of the Greeks and Romans, and Boccacio's *Decameron* drew "on the themes of medieval fabliaux" (p. 71). Chaucer and Shakespeare stole from everyone. A list of British and American writers before this century contains many names of those who copied shamelessly.

"In 1790 the first Federal copyright statute came into being" (Lindey, 1952, p.104), and attitudes toward copying slowly began to change. However, the borrowing did not stop. In 1987, Senator Joseph Biden spoke at the Iowa State Fair. His "phraseology, ideation, mini-scenes and plot" closely resembled those in a campaign commercial made by a British politician (St. Onge, 1988, p. 79). Within days, Biden's campaign for president was ended after reporters learned that he had failed a class for plagiarism while a law student at Harvard. A team researching Martin Luther King's writings was disappointed to discover that "King used the uncredited phrases and thoughts of other theologians in his university work" (Dean, 1990, p. E1). Later, other discoveries of extensive borrowing in King's work came to light.

---

[1] Lindey, 1952.

Student plagiarism has long been a problem for college professors. Students have always copied bits and pieces of information into their notes and thus into papers, often without proper attribution, and fraternities and sororities have long kept files of term papers. In the early 1980s, the *Daily Nebraskan* and most other college newspapers contained small, back-page ads offering term papers for sale. However, the murkiness of who owns what on the Internet, the ease of cut and paste copying, and the availability of free papers for instant downloading have made plagiarism more difficult to discover and easier to accomplish.

DEFINING PLAGIARISM

In referring to journalistic plagiarism, Lieberman (1995) makes the point that, "Definition is part of the problem. . ." (p. 21) and Bowers (1994) compares plagiarism to "an infection of silence" (p. 545). A student of language turns to the dictionary which defines plagiarism (Oxford English Dictionary, 1989), as, "The action or practice of plagiarizing; the wrongful appropriation or purloining, and publication as one's own, of the ideas, or the expression of the ideas (literary, artistic, musical, mechanical, etc.) of another" (p. 947).

In a handbook frequently used in college writing classes, Hacker (2000) points out that plagiarism has three aspects: "(1) failing to cite quotations and borrowed ideas, (2) failing to enclose borrowed language in quotation marks, and (3) failing to put summaries and paraphrases in your own words" (p. 399). St. Onge (1988) proposes the criteria of "*intentional verbal fraud committed by the psychologically competent that consists of copying significant and substantial uncredited written materials for unearned advantages with no significant enhancement of the materials copied* " [Emphasis in the original] (p. 101).

WHY THEY DO IT

Are plagiarists innocents who just don't know the rules? Perhaps. A study by Roig (1997) asked students to differentiate between plagiarism and paraphrasing. About three-fourths of the students were able to identify paraphrases, but as many as half identified instances of plagiarism as paraphrasing. Students seem to be unaware that borrowed text modified in minor ways constitutes plagiarism. This indicates the need for more extensive education on the skills of summarizing and paraphrasing.

On the other hand, experiments conducted by Tenpenny et al., (1998) led to "results [which raised] the possibility that inadvertent plagiarism rarely occurs when people attempt to produce truly original material" (p. 529). The group postulates that their results show that "previous work overestimated the occurrence of inadvertent plagiarism in the real world" (p. 555).

An unattributed article in *The Economist* (What's wrong with copying?, 1997) points out that, "Intention has a lot to do with it" (p. 78). Kibler et al., (1988) suggest that academic cheating occurs when individualism is more important than social values. Additional factors which contribute to cheating include student confusion about the definition of cheating, a lack of understanding of the long-term importance of the assignment, a focus on grades rather than learning and the fact that cheating is easy and frequently goes undetected. The "threat of being caught and punished" decreases cheating, but a professor's authoritarian classroom style, defined as an assumption of the intellectual inferiority of students, tends to increase cheating (p. 23).

St. Onge (1988) points out that "Emotional instability, questionable expositional skills, and temptation…lurks in the background of reported plagiarisms" (p. 3). Fitzgerald (2000) quotes others who believe that plagiarism resembles kleptomania, with the thrill of getting away with theft and the possibility of getting caught playing a part.

One key aspect is the plagiarist's tendency to borrow more than once. When Senator Biden was charged with plagiarism in 1987, reporters soon learned that in law school Biden had failed a course for plagiarism (St. Onge, 1988). Harvard psychiatrist Shervert H. Frazier resigned in 1988 after four instances of plagiarism and three of "careless scholarship" in his work were confirmed (Culliton, 1988, p. 1; Leo 1988).

Mike Barnicle, a columnist for the *Boston Globe*, stole jokes from George Carlin and was accused of plagiarism on three earlier occasions (Stein & Luscombe 1998; White 1998). Theft is not limited to the world of journalism. French film director Luc Besson used the work of other writers without giving credit at least four times (Williams 2000).

A search of nine sources revealed eleven excuses for plagiarism (Brahams, 1995; Fitzgerald,1993; Goode, 1993; Norman, 1984; Perrin, 1992; Stein, 1995; 1997a; 1997b, Strupp, 1999). The most frequent reason given (seven times) is that the writer's workload was so overwhelming that he or she just didn't have time to do the writing. Nearly as common was the *innocent mistake* excuse, mentioned five times. Family illness or problems was mentioned three times and kleptomania twice. Reasons found once included just using the framework of the source, trying to share credit but prevented, didn't copy it all, no copyright, and pressure on university professors to obtain grant money and publish their papers.

However, most plagiarists don't seem to offer reasons easily. Perhaps the comparison with kleptomania is apt, and the plagiarist has some inner need to get away with theft and lying. Indeed, the plagiarist resembles the classic impostor in several ways. Impostors are often seen in the medical world, but turn up on college campuses, too. They claim degrees and honors not received, and count on the laziness of those hiring them to not pick up the telephone and check references. Similarly, plagiarists claim to have completed work which in fact was merely copied from others.

SPECIAL TEMPTATIONS OF THE INTERNET

Plagiarists think that copying is easy, and that their theft will be difficult to detect. However, recently, flagrant examples of Internet theft have come to light. In 1995, a Miami Internet publisher accused another company of stealing Web pages containing a guide to events (Turner, 1995). Chinese Internet users have noticed increasing problems with the theft of home pages (On-line disputes emerge in China, 2000). Stebelman (1998) quotes Bruwelheide's point that students may believe "anything over the Internet is fair game and public domain, free of both legal and ethical intellectual property considerations" (p. 48).

Internet cheating by students takes two forms: 1) copying or paraphrasing sources without proper citation; and 2) downloading a whole paper from an online term paper seller. These forms are analogous to the old-fashioned, pre-Internet methods of copying from library sources without citing properly and buying a paper by telephone or mail from a paper mill.

A brief visit to www.schoolsucks.com revealed the ease with which papers can be downloaded. After accessing the site, the writer printed the main search page. Next, a search for a free paper was conducted using the term *Caribbean*. In less than a minute, brief descriptions of the first ten of thirty-one papers, conveniently listed alphabetically by subject area, appeared on the screen, accompanied by encouragement to disregard the "sucky" or "garbage" papers and look up others which are better and available for purchase.

A few papers appeared in more than one category. The writer then clicked on the link for a paper on cacao, and a nine-page paper appeared (Theobroma cacao, 2000). However, an attempt to print the paper directly from Netscape resulted in blank pages. The paper was then copied and pasted into WordPerfect. This worked well, although the document was unformatted.

Finally, the writer e-mailed the paper to herself, and this copy also came through without formatting, but with citations and bibliography intact. All the paper needed was proper formatting and a name, and it would have been ready to hand in. The paper contained numerous errors in grammar, punctuation, and usage which a student might not notice. The Evil House of Cheat (2000) site offered access to fifty-nine papers under the C*aribbean* heading, but would not send one without a credit card number.

DETECTING AND PREVENTING PLAGIARISM

Faculty members often prefer to discuss plagiarism with the individual student rather than making formal charges. Fain (2000) points out factors which negatively affect reporting, including "administrations pushing student retention, litigatious students, [and] students threatening physical harm" (p. 1). Despite Martin Luther King's extensive borrowing from the works of famous theologians as well as the dissertation of another student, his professors either failed to detect or refused to acknowledge his errors (Garrow 1990).

St. Onge (1988) describes two methods of discovering plagiarism: "accidental and by deliberate search" (p. 64). Accidental detection occurs when the professor reading a paper suddenly sees a jump in style from student to professional. This method of detection depends on familiarity with the individual student's writing ability. This type of plagiarism is more easily detected when the instructor requires several papers in a semester and keeps a sample of each student's writing for reference (Kibler et al., 1988). St. Onge (1988) points out that, "The student's native style and idiom is quite unlike the rather formal exposition of professional writers…the student's insertions and adaptations contrast sharply with the original text" (p. 65).

Once plagiarism is suspected, a deliberate search for source materials can be conducted. If plagiarism is suspected, finding the plagiarized materials may be easier on the Internet than in the library days of years past. "Unique phrases within a suspect essay" can be typed into search engines, and the "find related articles" feature enables an even more comprehensive search (Stebelman, 1998, p. 49).

The downloading and copying of whole papers can be more difficult to detect because these papers are written at a level well below that of professional sources. Plagiarists, despite their penchant for theft, are often incredibly dumb and unsuspecting. For instance, a downloaded paper may have a Web address at the top of the page, gray letters in the text which indicate Internet sources, or a tag on the end of the paper with the name of the source site. These papers may refer to imaginary sources or sources not found in the library, professors not teaching at the university, and inactive Web sites. A clear giveaway is sources which are more than a few years old because free papers have usually been in circulation for many years. In doubtful cases, a student can be required to bring in copies of research materials, to discuss the main points of the paper and to explain specific passages (Fain, 2000).

Several Internet sites offer plagiarism detection services or software. In an attempt to see how well the How Original.com (2000) plagiarism detection site works, this writer copied four sentences from the paper on cacao obtained from School Sucks into the check window. A few minutes after the sample was submitted, an email arrived with directions to the report. According to How Original.com (2000), the four sentences did not match anything in their database. This checking site did not catch the paper downloaded so quickly and for free. How Original.com was fast and easy, but unfortunately ineffective.

Another site offering testing is Glatt Plagiarism Services, Inc.(2000). They want to sell a CD-Rom containing their program to individual professors and institutions, but a sample self-test is available. At their Web site, the same four sentences from the cacao paper were copied into the window. Next the writer took a brief test which consisted of filling in missing letters in the alphabet and solving simple math problems. Then the program presented the sample with every fifth word removed. The writer had little trouble filling in the missing words and submitted the sample for evaluation. The score was 90%, and Glatt suggests that the paper be rewritten to eliminate possible plagiarism if the score is 50% or below.

This program didn't detect that the sample was from an online paper, either. If this method works, it might be easier for an individual professor to white-out every fifth word in one page of a student paper, copy the page, then ask the student to fill in the blanks.

The final attempt to check the cacao paper was TurnItIn.com (2000). This attractive Web site with old-fashioned photos of students and professors--perhaps signifying the good old days when faculty didn't have problems like plagiarism--wants to sell the document source analysis, student peer review and digital archiving, but also offers a free trial entitling the user to submit for analysis up to five manuscripts in thirty days. This time the entire cacao paper was offered and an analysis in 24 to 48 hours was promised. Within minutes, the writer received an e-mail with a password, and less than five hours later the cacao paper had been analyzed, with 26% to 50% found to match other material. While allowing more text to be analyzed with greater success, TurnItIn (2000) is also significantly slower than HowOriginal.com (2000) and Glatt Plagiarism Services (2000), which both offer almost instant analysis of small amounts of text.

REDUCING PLAGIARISM

"The notion that punishment is a cure for plagiarism is about as sound as the notion that punishment cures anything. Punishment certainly inhibits some but leaves others completely undeterred" (St. Onge, 1988, p. 42). According to Stebelman (1988), "Eliminating cybercheating is an unrealistic goal, but reducing it is not" (p. 51).

Universities can attack directly one source of the problem. Two years ago, Boston University conducted a sting operation in which by having a student purchase papers from several Internet paper mills. "...eight companies in seven states [were charged] with violating a Massachusetts law that prohibits the sale and marketing of term papers (Roach, 1998, p. 26).

Professors can do their part to lessen the temptation to plagiarize offered by the Internet. Even those who teach geology or physics or music, but require students to write papers, must teach writing. Stebelman (1998) recommends that instructors make themselves aware of papers available on Internet paper mill sites, take students to the sites to look at the problems of papers available there, teach students how to use and properly cite Internet materials in their writing and assign specific paper topics which are harder to cheat on than more general assignments.

Openly discussing plagiarism with students and preparing handouts which define and demonstrate academic theft are also important. Assignment techniques which decrease the potential for plagiarism include narrowing possible topics and holding students to a particular format. These two techniques can make use of downloaded papers difficult. In addition, teachers can use a criterion-based grade sheet, require a draft bibliography and outline early in the assigned writing time, encourage students to hold to their original topics (topic switching and procrastination encourage plagiarism), and require that rough drafts be turned in with the final paper (Kibler et al., 1988).

REFERENCES

Bowers, N. (1994). A loss for words: Plagiarism and silence. *American Scholar, 63*(4), 545-556.

Brahams, D. (1995). Conflicting views on alleged plagiarism. *The Lancet, 345*(8946), 379.

Culliton, B. (1988). Harvard psychiatrist resigns. *Science, 242*(4883), 1239-1240.

Dean, P. (1990). The paper chase. *Los Angeles Times, December 11*, E1.

Evil house of cheat. (2000). [On-line], Available: http://222.cheathouse.com/uk/index.html

Fain, M. (2000). *Cheating 101: Paper mills and you.* [On-line], Available: http://www.coastal.edu/library/papermil.htm

Fitzgerald, M. (1993). An apology for plagiarism. *Editor and Publisher, 126*(23), 9-10.

Fitzgerald, M. (2000). Why they do it. *Editor and Publisher,* (23), 9-10.

Garrow, D. (1990). How King borrowed; reading the truth between sermons and footnotes. *The Washington Post, November 18,* C1.

Glatt Plagiarism Services. (2000). [On-line], Available: http://www.plagiarism.com/index.htm

Goode, S. (1993). Trying to declaw the campus copycats. *Insight on the News, 9*(18), 10-17.

Hacker, D. (2000). *Rules for writers.* Boston: Bedford/St. Martin's.

How Original.com. (2000). [On-line], Available: http://www.howoriginal.com.

Kibler, W., Nuss, E., Paterson, B., & Pavela, G. (1988). *Academic integrity and student development: Legal issues and policy perspectives.* Asheville, North Carolina: College Administration Publications, Inc.

Leo, J. (1988). The Crimson copycat. *U.S. News and World Report, 105*(23), 90.

Lieberman, T. (1995). Plagiarize, plagiarize, plagiarize, only be sure to always call it research. *Columbia Journalism Review, 34*(2), 21-26).

Lindey, A. (1952). *Plagiarism and originality.* New York: Harper.

Norman, C. (1984). Stanford investigates plagiarism charge. *Science, 224*, 35-36.

On-line disputes emerge in China. (2000). *Xinhua News Agency, March 28*, 1.

Oxford English Dictionary. (1989). *Plagiarism.* Oxford, UK: Oxford University Press.

Perrin, N. (1992). How I became a plagiarist. *American Scholar, 61*(2), 257-259.

Roach, R. (1998). High-tech cheating. *Black Issues in Higher Education, 15*(22), 26.

Roig, M. (1997). Can undergraduate students determine whether text has been plagiarized? *The Psychological Record, 47*(1), 113-122.

St. Onge, K. (1988). *The melancholy anatomy of plagiarism.* Lanham, Maryland: University Press of America.

Stebelman, S. (1998). Cybercheating: Dishonesty goes digital. *American Libraries, 29*(8), 48-51.

Stein, J., & Luscombe, B. (1998). Theft, or cutting corners? *Time Canada, 152*(7), 56.

Stein, M. (1995). Twice burned. *Editor and Publisher, 28*(23), 13-14.

Stein, M. (1997a). Movie critic fired for plagiarism. *Editor and Publisher, 130*(13), 3.

Stein, M. (1997b). Plagiarism unwittingly published. *Editor and Publisher, 130*(34), 10.

Strupp, J. (1999). Columnist suspended. *Editor and Publisher*, 12, 12.

Tenpenny, P., Keriazakos, M, Lew, G., & Phelan, P. (1998). In search of inadvertent plagiarism. *American Journal of Psychology, 111*(4), 529.

Theobroma cacao: *Food of the gods*. . [On-line], Available: http://www.schoolsucks.com/search

Turner, A. (1995). Firm claims plagiarism; Sues Internet competitor. *South Florida Business Journal (Miami-Dade Edition), 16*(15), 5A.

Turn It In.com. (2000). [On-line], Available: http://turnitin.com/free-trial.html

What's wrong with copying? (1997). *The Economist (US), 342*(8011), 77-78.

White, J. (1998). I was just thinking . . . some unoriginal thoughts about plagiarism and race. *Time, 152*(8), 47.

Williams, M. (2000). Plagiarism charges mount against Besson. *Variety, 378*(3), 6.

VIRTUAL WORLDS IN LARGE ENROLLMENT SCIENCE CLASSES SIGNIFICANTLY IMPROVE AUTHENTIC LEARNING

Phillip McClean
Bernhardt Saini-Eidukat
Donald P. Schwert
Brian M. Slator
Alan White
North Dakota State University

INTRODUCTION

An emerging pedagogy, *authentic instruction* (Brown et al., 1989), defines an approach that treats content as support knowledge needed to solve challenging, real-world problems. Authentic instruction places the learner in the environment of the doer, and while in that environment, the learner assimilates the practices and beliefs associated with a particular discipline. This assimilation is a direct result of the learner performing activities unique to that discipline. For example, to learn cell biology, the learner would visit a lab filled with the equipment and reagents and perform authentic cell biology experiments.

Unfortunately, to offer such an experience to a large number of students is prohibitively expensive. The challenge for geology teaching is even more daunting--it is impossible to transport hundreds of students to the many physical environments necessary to perform those relatively simple, but unique experiments that are necessary to support problem solving. Without these economic limitations, authentic learning would support the active engagement of student-centered collaborative learning of the principles and practices that define science and its discipline. So what options are available to provide authentic learning in our cost-constrained educational institutions?

Properly designed computer-aided courseware that render cell biology laboratories or geological worlds can potentially support authentic instruction anywhere a monitor is available. Importantly, the cost of the authentic experience is then pro-rated into the technology budget of the school. Therefore, the educator is challenged to either identify off-the-shelf software that supports the authentic learning pedagogy or develop new courseware. At North Dakota State University the World Wide Web Instructional Committee chose the latter approach. Here is provided evidence from large experiments that graphical or text-based virtual worlds designed to support authentic instruction in cell biology and geology can significantly improve the student's ability to solve authentic problems associated with those two disciplines.

DESCRIPTION OF THE STUDY

The World Wide Web Instructional Committee (http://www.ndsu.edu/wwwic) is a multi-disciplinary group of North Dakota State University faculty engaged in the development of virtual/visual worlds for science education. The worlds communicate both the scientific method and discipline-specific content and are role-based, goal-oriented, learner-oriented, immersive and exploratory (Slator et al., 1999). The worlds employ consistent elements across disciplines and, as a consequence, foster the sharing of development plans and development tools. Of particular interest for the experiments described here are two virtual worlds, the *Virtual Cell* (White et al., 1999) and the *Geology Explorer* (Schwert et al., 1999). Each is hosted on the Internet and has the capability of multi-user interactions. The common technology is a LambdaMoo (Curtis, 1998)--MUD Object Oriented--server and database that contains the contextual material (help file and experimental output data) and controls the single and multi-user connectivity and interactivity. For the Virtual Cell (http://vcell.ndsu.edu), LambdaMoo also manages the three-dimensional display of Virtual Reality Modeling Language (VRML) worlds representing a virtual laboratory, the interior of the cell and its organelles. The display of the world and its direct interactivity is managed by a Java applet. The version of the Geology Explorer used in the experiments described here utilized the textual interface features of LambdaMoo. A graphical version of the Geology Explorer is now available (http://oit.cs.ndsu.nodak.edu/).

The basic experimental design for the Virtual Cell and Geology Explorer experiments were nearly identical. Student volunteers were recruited from a large enrollment introductory-level general science class (General Biology or Physical Geology) with the offer of extra credit points. The Virtual Cell experiment was performed with two sections taught simultaneously by different instructors, whereas the Geology Explorer experiment involved a single section. Each student volunteer and non-volunteer completed a pre-treatment scenario-based assessment exercise. These exercises were problem-based questions specific to one of the disciplines. (Visit http://www.ndsu.edu/wwwic/vc/evaluation/eval2.htm for the Virtual Cell scenarios.)

Within each course, the volunteers were assigned randomly to one of two groups based on data from a student-completed survey (http://www.ndsu.edu/wwwic/vc/evaluation/eval1.htm) that characterized their computer literacy, gender, and prior laboratory experience. The Virtual Cell group completed authentic Organelle Identity and Cellular Respiration activities in the virtual world and the World Wide Web group performed two computer-based Web exercises that required a similar amount of time with computer-based activities. The Geology Explorer group was assigned a single authentic mineral identification activity and the corresponding Alternative completed an exercise requiring Web-based activities. For both experiments, non-volunteers formed the control group and performed no additional educational activities.

About one month after the activities were completed and just prior to the end of the semester, students completed post-intervention scenario-based assessments. A total of 334 and 368 students participated in the Virtual Cell and Geology Explorer experiments, respectively. Multiple student graders trained against a standard approach scored the pre- and post-intervention scenario assessments. For both experiments, a score of 100 was indicative of the score a professional in the field would obtain. Because a significant correlation of scores for the Virtual Cell graders was observed, the mean score was used as the experimental observation.

A separate goal of the Geology Explorer experiment was to evaluate fourteen assessment scenarios (as opposed to just one used for the Virtual Cell experiment). Because of smaller sample size per scenario, reliable correlations of grader scores within a scenario could not be obtained. Therefore, the scores of each grader were evaluated separately.

FINDINGS

Two-way analysis of variance (ANOVA) were performed to determine if any significant Virtual Cell treatment effects could be detected. The observation that the means between the two class sections were not significant implies the teaching approaches by the instructors in the two sections did not confound the student scenario assessments scores. The ANOVA also demonstrated the post-intervention mean score of the Virtual Cell group was significantly higher than the corresponding score for the World Wide Web and Control groups (Table 1).

Table 1. Mean Post-Intervention Scenario Scores For 1999 Virtual Cell Experiment With NDSU Biology 150 (General Biology) Students.

	Module	
Mean	Organelle Identification	Cellular Respiration
Controla	17.4a	10.6a
WWW	19.7b	13.7b
VCell	22.7c	17.3c

aTreatment population sizes are: Control=145; WWW=94; and Virtual Cell=93.

Within any column, any two means followed by the same letter are not significantly

different at P=0.05 using the LSD mean separation test.

This large experiment clearly demonstrates the Virtual Cell experience had a significantly positive effect on the ability of students to solve problems in the mode of a cell biologist. The fact that the Virtual Cell group mean was significantly higher than the World Wide Web group strongly suggests the improved ability was not simply the result of computer-based time-on-task, but rather was directly related to the Virtual Cell experience. In addition, the results demonstrate the World Wide Web group mean scores were significantly higher than those of the control group. Because of several confounding factors, it is more difficult to adequately explain these mean performance differences. This difficulty, though, does not diminish the significant improvement in performance demonstrated by the students who used the Virtual Cell.

For the Geology Explorer experiment, the data were analyzed by Analysis of Covariance to adjust for variation associated with pre-intervention scenario assessment score and variation associated with varying degree of difficulty of the fourteen post-scenario assessments (versus one for the Virtual Cell experiment). Consistent with the results of the Virtual Cell experiment, the mean post-intervention scores for those students completing Geology Explorer goals were significantly higher than the alternative and control groups (Table 2). Although the means of the three graders varied, the trend of Geology Explorer students performing better on the authentic assessments was consistent. Unlike the Virtual Cell experiment, the control and alternative group mean scores were not significantly different.

Table 2. Mean Post-Intervention Scenario Scores For 1998 Geology Explorer Experiment With NDSU Geology 105 (Physical Geology) Students.

	Grader		
Mean	One	Two	Three
Controla	25.1a	25.5a	44.5a
Alternative	29.3a	27.0a	42.6a
Geology Explorer	40.5b	35.4b	53.4b

aTreatment population sizes are: Control=195; Alternative=95; and Geology Explorer=78. Within any column, any two means followed by the same letter are not significantly different at P=0.05 using the Duncan's multiple range mean separation test.

CONCLUSIONS AND RECOMMENDATIONS

Given the consistent experimental approach employed, it is concluded that the use of virtual worlds designed as active, authentic learning environments can positively impact student learning. In general, the authors recommend such authentic learning as a component of science learning.

The one-time cost of technology may be expensive, but it is not a recurring cost such as annually funding laboratory exercises or transporting students to remote learning sites. For upper division courses with smaller enrollments, such traditional approaches may be economically feasible, but transitioning to a virtual world approach for larger enrollment classes appears warranted, and is advocated.

REFERENCES

Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational Researcher, 18,* 32-42.

Curtis, P. I. (1998). Not just a game: How LambdaMOO came to exist and what it did to get back at me. In C. Haynes & J. R. Holmevik (Eds.), *High wired* (pp. 25-42). Ann Arbor, MI: University of Michigan Press.

Schwert, D. P., Slator, B. M., & Saini-Eidukat, B. (1999). A virtual world for earth science education in secondary and post-secondary environments: The geology explorer. *Proceedings of the International Conference on Mathematics/Science Education &Technology*, 519-525.

Slator, B. M., Juell, P., McClean, P., Saini-Eidukat, B., Schwert, D., White, A., & Hill, C. (1999). Virtual worlds for education. *Journal of Network and Computer Applications, 22*, 161-174.

White, A., McClean, P. & Slator, B. M. (1999). The virtual cell: An interactive, virtual environment for cell biology. *Proceedings of the World Conference on Ed Media and Hypermedia (ED-MEDIA 99),* 1444-1445.

Note: This research was supported in part by National Science Foundation grants DUE– 9752548, EAR-9809761, and DUE-9981094.

USING STREAMING VIDEO TECHNOLOGY IN TEACHER EDUCATION

Edwin McClintock
Zhonghong Jiang
Florida International University

INTRODUCTION

In recent years streaming video has gradually become increasingly important as a communication medium. It has provided educators with an excellent tool to increase speed and simplify the delivery of multimedia content to their students. In mathematics education, while it is necessary for preservice teachers to study important theories of teaching and learning, it is also necessary for them to study best practices in the field. Inservice teachers, for professional development purposes, also need to do so.

Video seems to be one of the best tools to help introduce teachers to best practices. Video resources are dynamic in nature and much more vivid and "realistic" than text and static graphics presentations. For many years, only videotapes were available. In terms of good quality products in mathematics education, however, videotapes were very limited. More recently, video CDs and DVDs have been used, but the same limitations exist even though the situation has improved.

Since the World Wide Web became a primary means of disseminating information, educators and their students have been able to access and use many more video resources than ever before through navigating a variety of Web sites. Before streaming video became available, however, the video files had to be downloaded from a server and stored at the client before they were played. The downloading process required considerable time and space on the hard drive. Therefore, most educators and students could not make use of these resources.

With video streaming, a technology that avoids the need for the user to download large files but instead plays them directly from the Web server, the limitations mentioned above have been overcome. Video streaming enables the user to select and receive video content from the Internet and to begin viewing content almost immediately after selection and receiving (usually with a delay of only a few seconds).

Streamed files also do not require much bandwidth (the amount of information that a communications link can carry), so they can be displayed on computers that connect to the Internet via modems. Furthermore, the video pieces that have already played are automatically removed. Thus, video streaming allows both educators and students to view very large video files without having to collect and store them. Since video streaming has such advantages, the authors have been using it in mathematics teacher preparation and the professional development of inservice teachers.

USING EXISTING STREAMING VIDEOS ON VARIOUS WEBSITES

Along with the rapid development of Web technology, many excellent Websites have been adding video streaming to their content to better present the best practice in mathematics education. For example, the Website of the National Council of Teachers of Mathematics (NCTM) puts a series of streaming video segments on its sub-page *Illuminations* (http://illuminations.nctm.org/). This sub-page has a part called *Reflections on Teaching* that consists of activities designed to encourage thinking and discussion about teaching and learning mathematics. Most of these reflection activities are centered around video vignettes of teachers teaching math or students learning math.

In the undergraduate mathematics methods course at Florida International University, watching and discussing video vignettes like those on the *Illuminations* Web page is an important learning activity on the part of the students (preservice teachers) and one of the major components of the course. Preservice teachers have also found they can learn a great deal through this activity. When they observe how the exemplary teachers engage their students in active mathematics investigations (thereby learning about students' level of conceptual understanding through monitoring small group and whole class discussion), they get a real sense of what effective teaching looks like.

For example, they watched and seriously studied a group of video clips on *Illuminations* that showed a teacher delivering a lesson on reflection, writing and communication. From this experience, the preservice teachers realized that the exemplary teacher played an important role in facilitating and fostering communication resulting in the development of students' mathematical understanding. They pointed out:

> *Integrating the story in the discussion helps the students relate a new mathematical concept to something that they already know. It makes the concept relevant to areas outside of just the math class.*
>
> *It affords us the opportunity to experience some possible answers students may give as responses. If we know the types of answers students will give, then we can be prepared*

> *with responses as well as probing techniques.*
>
> *I learned from this streaming video the importance for students to write their thoughts on their own and later discuss their ideas with others in order to arrive at more meaningful conclusions.*

Not only the preservice teachers but also many inservice teachers have benefited from these video resources. These inservice teachers participated in the professional development workshops sponsored by the funded projects that the authors direct or co-direct. When the teachers watched these video clips at the workshop sessions or at home using their own computers, they experienced a classroom environment significantly different from traditional teaching--an environment in which intellectual risks, sense making and deep understanding were expected.

Teachers felt that the streaming video clips were excellent as resources to enhance their teaching because the video clips provided ideas for teaching mathematics concepts, opportunities for reflection on the outcomes of the lessons and evaluation of student involvement. On the one hand, they realized that learning to teach to new standards takes time and is not easy; on the other hand, they agreed that new ways of teaching must be developed--these resources helped them to become confident in developing and implementing these new ways. Their feedback included words such as *We now have models to follow,* and *Other teachers can, why can't we?*

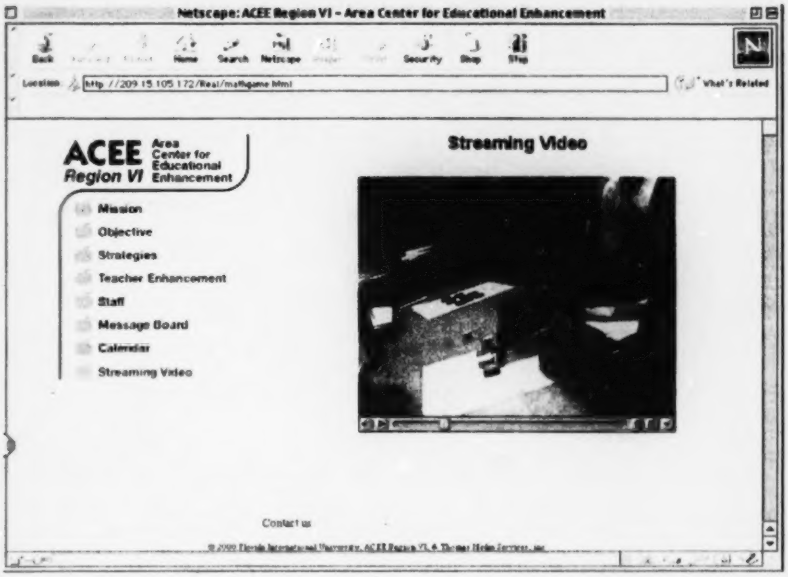
CREATING STREAMING VIDEOS ON THE AUTHORS' COURSE/PROJECT WEBSITE

Introducing Teachers to Best Practices

Because of specific needs of the methods course, it was not sufficient to solely rely on existing streaming videos for best practices. The authors felt a need to integrate video streaming into their course/project Website as well.

For example, when students enrolled in the course were learning how to teach probability concepts, the authors could not find an appropriate video file on the Web. However, while visiting a middle school in Los Angles for the purpose of evaluating a project, one of the authors observed an excellent class in which the teacher facilitated the students' learning of probability concepts by engaging them in playing probabilistic games. He videotaped the class and created a streaming video clip on the course/project Website, http://209.15.105.172/ (see Figure 1). Since class time was insufficient for the authors to accomplish the course objectives and since the students could watch the video at flexible times and locations, the authors assigned student groups to watch and study it during their spare time. Based on the students' positive feedback, the authors have found that streaming video is an excellent enhancement to their course/project Website.

Figure 1. Middle School Students Learn Probability Through Games


Netscape: ACEE Region VI – Area Center for Educational Enhancement
Back
Home
Search
Netscape
Security
Shop
Stop
Location:
http://209.15.105.172/Real/mathgame.html
What's Related
ACEE Region VI Area Center for Educational Enhancement
Streaming Video
Mission
Objective
Strategies
Teacher Enhancement
Staff
Message Board
Calendar
Streaming Video
Contact us

Strengthening Teachers' Mathematical Content Knowledge

There is general agreement that strengthening of mathematical content knowledge is required for the next decades. The information age requires deeper knowledge of mathematics of all citizens. At the same time, this knowledge must be highly functional in terms of its use in real world applications.

Problem solving is at the core of learning and doing mathematics. Mathematical modeling as a problem-solving approach opens opportunities for introducing advanced content by demonstrating practical applications in the context of the model. Research studies point out that teachers' expertise is the most important factor in determining student achievement. (Darling-Hammond &

BEST COPY AVAILABLE

Ball, 1997). Content knowledge is key to learning how to teach content so that students are able to understand it.

Mathematics teachers' effectiveness depends on what and how well they understand mathematics. To help students become capable problem solvers, preservice and inservice teachers should first *be* such problem solvers. Therefore, it is crucial to continue strengthening teachers' mathematical content knowledge (as well as their pedagogical content knowledge), and especially to continue developing teachers' problem-solving and mathematical modeling abilities.

For preservice teachers, video streaming is an excellent supplement to classroom instruction in the aspect of problem solving and mathematical modeling. As instructors, the authors always emphasize problem solving and mathematical modeling. However, limited class time only allows them to lead the students to investigate a few examples in class. Most of the mathematics problems are assigned through the course/project Website for students to explore.

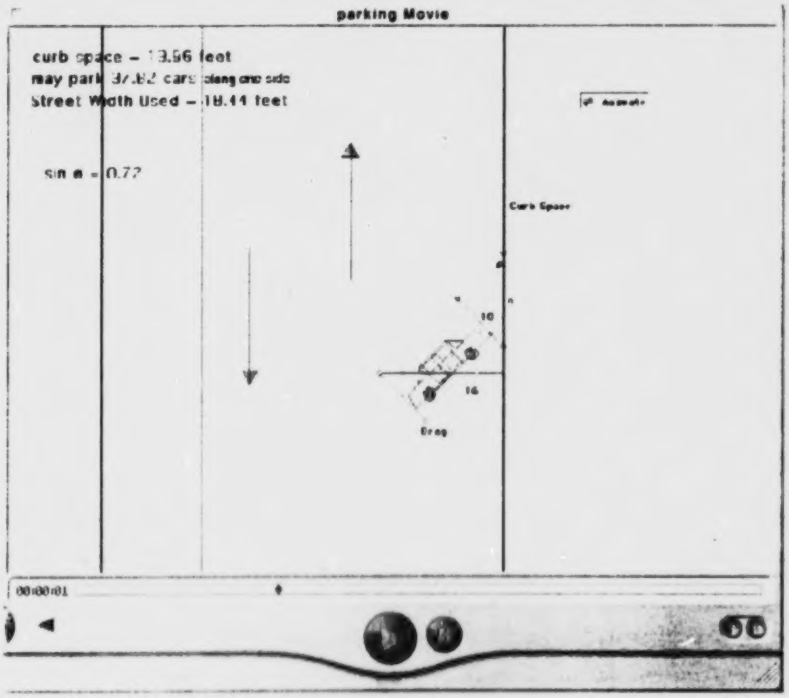
For selected problems (that usually are more challenging), visual representations and/or animations are created using video streaming, to help students make more sense of the problem situations and further their explorations. An example is provided below (Swetz & Hartzler, 1994).

> ***STREET PARKING.*** *You are on the planning commission for Algebraville, and plans are being made for the downtown shopping district revitalization. The streets are 60 feet wide, and an allowance must be made for both on-street parking and two-way traffic. Fifteen feet of roadway is needed for each lane of traffic. Parking spaces are to be 16 feet long and 10 feet*

> *wide, including the lines. You job is to determine which method of parking--parallel or angle--will allow the most room for the parking of cars and still allow a two-way traffic flow. (You may design parking for one city block (0.1 mile) and use that design for the entire shopping district.)*

When exploring this problem, a considerable number of students intuitively conjectured that the angle parking was better than parallel parking. The parallel parking situation was quite simple and students quickly determined how many cars could be parked in one city block. However, most of the students had difficulties finding a mathematical solution for the angle-parking situation other than the intuitive conjecture. The authors created a video clip (see Figure 2) for students to view either in or after class.

Figure 2. A Mathematical Modeling Video Clip



curb space = 13.56 feet
may park 37.82 cars along one side
Street Width Used = 18.44 feet

sin a = 0.72

Through playing the video, the students clearly saw that in order not to block traffic, the left side of each parking space had to be "dragged down" so that the shaded rectangular area was completely away from the 15 feet traffic lane (or at most "touching" the traffic lane at one point only). Doing so made the curb space very long, resulting in the fact that much more space was wasted and fewer vehicles could be parked in one city block. This visual feedback successfully helped the students correct their misconceptions. Using similar-triangle relationships and the Pythagorean Theorem, the students finally arrived at the correct mathematical solution and understood why parallel parking was often used in downtown areas where most of the streets were relatively narrow.

For the inservice teachers participating in the professional development projects with the authors, video

BEST COPY AVAILABLE

streaming has played an even greater role. Limited time for them to work together makes video streaming an ideal means of making continuous progress across distance and time.

Taping and streaming video discussions and representations of the modeling process allow flexibility of study and communication. For example, the modeling problem and the related streaming video clip introduced above were also presented to the inservice teachers, but completely through the course/project Website. The teachers explored the problem individually or in small groups on the computers at either their home or school at times that were most convenient to them.

From feedback from the teachers, the authors were able to determine: 1) teacher misconceptions when first approaching the problem--their exploration processes on solving the problem were similar to those of the preservice teachers; 2) playing the video clip did help them realize and correct their misconceptions; and 3) some hints from the authors were requested. The authors sent the hints through e-mail to the teachers who asked for help. Ultimately, the authors received the correct solutions to the problem from all participating teachers.

A TOOL THAT CAN BE USED IN INSTRUMENTAL SYSTEMIC REFORM IN MATHEMATICS

A clear, shared vision of mathematics reform is required for the vision to become systemic. National and International leaders who draw their powerful ideas from research have real potential for helping establish a shared vision. Yet those who operationalize a vision must have opportunities to experience and inquire into the ideas and research both first-hand and as interpreted by visionary leaders. Opportunities for those who carry out the planning for reform to hear and interact with these leaders are limited--but with video streaming, this can be accomplished.

As an example of the way that a vision for reform may become a shared, systemic one, the Florida State University System Partners for Excellence in Education (a professional development project that one of the authors co-directs), held an orientation conference at the beginning of the project. The Chancellor of the State University System of Florida addressed the conference and provided the project a direction-giving charge.

Through the inspirational descriptions of the vision of the project, the Chancellor established a promising collaboration of the university system and a selection of large public school districts across the State. The participants at the conference included distinguished teachers, university faculty, department of education officials, school district administrators (principals and superintendents), and a host of other individuals including legislators. Although these individuals would direct and provide guiding leadership for the Partners Project, they were, by no means the majority of those who would be touched by the project.

However, through video streaming, this address by the Chancellor was viewed by a much more inclusive set of stakeholders including school and university personnel, business leaders, governmental officials and students in the state university System. In the same way, the President of the International Mathematics Olympiad inspired conference participants and many others through streaming video--with visions of what mathematics is and the directions teaching and learning can go. Both addresses are available at http://209.15.105.172/video.html. They represent examples of vision-setting potential in video streaming, effectively expanding the opportunity of all related parties to study, discuss, and draw upon these visions for the planning of professional and systemic reform.

HOW TO CREATE STREAMING VIDEO

The steps that the authors followed to create streaming video were: 1) a digital camcorder was used to do videotaping, or preparing the visual representation for a problem situation with a specific application, e.g., The Geometer's Sketchpad (Jackiw, 1995); 2) video capturing software was used, e.g., Final Cut Pro or iMovie, or specific application software, e.g., The Geometer's Sketchpad, to create the video content that was needed; 3) the video content was edited with video editing software, e.g., Final Cut Pro or iMovie; 4) video compression software, e.g., Media Cleaner, was used to compress the edited video if it was very large in terms of storage space; and 5) the video (or compressed video) was uploaded to the server.

The video then became available for streaming to the user's computer. The user could watch it using a video player, e.g., Real Player or QuickTime. These basic players are free for the user to download from the Internet.

CONCLUSIONS

The authors have been using streaming video technology in helping both preservice and inservice teachers develop their mathematical content knowledge and pedagogical content knowledge. Emphases have been on introducing these teachers to best practices in mathematics education and engaging them in problem solving and mathematical modeling activities. Feedback from teachers indicates that video streaming can effectively supplement classroom instruction of the mathematics methods course and greatly enhance the professional development of the inservice teachers. The authors have also found that video streaming is a useful tool for instrumental systemic reform in mathematics.

REFERENCES

Darling-Hammond, L., & Ball, D. (1997). *Teaching for high standards: What policymakers need to know and be able to do* (prepared for the National Education Goals Panel). Unpublished manuscript.

Jackiw, N. (1995). *The geometer's sketchpad* (Software). Berkeley, CA: Key Curriculum Press.

Swetz, F. & Hartzler, J. (1994). *Mathematical modeling in the secondary school curriculum: A resource guide of classroom exercises.* Reston, VA: National Council of Teachers of Mathematics.

ANATOMY-PHYSIOLOGY
AS AN INTENSIVE, INTEGRATED LECTURE/LAB-
MAKING IT WORK

Holly J. Morris
Lehigh Carbon Community College

INTRODUCTION

Presenting anatomy-physiology in a manner which students will understand and remember is a challenge. Attempting to present that material in a compressed time-frame without sacrificing learning objectives, as with a summer class, can be daunting.

According to Leonard (2000), the majority of college students are not successfully learning science. At the same time, the majority of science faculty use lecture as their primary, or possibly only, teaching method. Modell (1993) observed that lectures in comparable courses taught by different faculty, or at different institutions, were remarkably similar. The lecturer stands at the front of the room and disseminates information. As Boyle (1993) stated:

> Lectures provide the faculty with an opportunity to present large volumes of information to large groups in a short time. Some faculty view this process as an efficient way to teach. The question that arises is: how effective is this method of teaching? (p. 99).

Summer courses are taught at most colleges and universities in a compressed time-frame. A course that would run for a duration of 15 weeks during the academic year may be squeezed into five weeks during the summer. The learning objectives for courses are supposed to be the same regardless of the time-frame, but many faculty find that students learn and retain less information in a typical summer course.

The literature abounds with books and articles on active learning, critical thinking and problem solving in the classroom (Barnes, 1992; Bowan, 1998; Bransford et al., 1999; Modell & Michael, 1993). The students' active involvement in the subject matter enhances not only their ability to understand, but also to solve problems and think critically.

In this rapidly growing information age, it is imperative that learners have the ability to think critically in order to seek solutions to problems society has not yet begun to imagine (Westaway, 1999). In developing critical thinking skills, the life-long learner can develop an ability to sift through contradictory, incomplete, or obsolete information and develop, as Cromwell (1992) says, a strategy for dealing with the world. This strategy starts in a classroom of active learners.

Active learning has many components. It addresses the different learning styles that students bring to the classroom. Since people learn in different ways, the teacher needs to teach in different ways. The brain's optimum learning environment is variety--a variety of people, learning levels, teaching methods, activities, interactions, and so on (Bowan, 1998).

The task, then, was to create a summer anatomy-physiology course which would be a learning experience and not just fulfill seat-time. Science courses, such as anatomy-physiology are typically taught with separate lecture and laboratory components. The goal for this course was to create an immersion-style course that used active-learning strategies. The plan was piloted with one section of Anatomy-Physiology I in the summer of 2000.

DESCRIPTION OF THE STUDY

The course was run in a five-week summer session and took place entirely within the laboratory. Course material was divided into five units and each unit was covered in one week. The course met Monday through Thursday on the following schedule:

Monday and Wednesday--9:00am to 3:15pm
Tuesday and Thursday-- 9:00am to 11:30am

The course was divided into the following five units: week 1--Introduction and Histology; week 2--Bones and Joints; week 3--Muscles; week 4--Nervous System 1; and week 5-- Nervous System 2.

On the first day of class students were impressed with the importance of reading the appropriate chapters in the textbook and laboratory manual before coming to class each day. They were also given a description and demonstration of active learning and a list of faculty and student responsibilities.

An Average Week

An average week (after day one) is described below.

Monday. New material is presented. The day usually begins by asking students questions, both to ensure that they have read the textbook and to assess their levels of understanding. To make the exercise a little less intimidating, students are given latitude on what to answer.

A typical exchange would go as follows: a student would be selected as the starting point and asked to describe something that he or she had learned about bone tissue, for example. Then, moving in sequence around the lab, each person would be asked to add something. If a student got stuck, he or she could ask for help from other class members. This process would continue until no one could add anything further. Students were asked if anything that had been described by other classmates was unclear. At this point lecture would begin, but modified so as not to repeat material that the students already understood.

This technique is used frequently throughout the course when beginning a new topic. It is also used at the end of some topics as a way to review the material.

The duration of the lecture components varies from about 15 to 45 minutes, depending on the complexity of the concept and the ability of the students to remain seated on the lab stools. Shorter is generally considered to be better. Lectures are interspersed with hands-on applications (laboratory exercises). In a given day, lecture and lab would alternate three or four times.

After a topic is introduced, students begin a laboratory exercise in which they work in pairs or groups of four. Mini-lectures (five to ten minutes) are often used during these hands-on sessions. (It is much easier, for example, to discuss the function of bone markings when students are holding bones in their hands.) Most of the time, the instructor moves from table to table, asking and answering questions, while students work at their own pace. At the end of the day there is a recap of the material covered and students are encouraged to review their notes and reread text material that evening.

Tuesday. The day begins with questions from the students. When they run out of questions, they are asked questions by the instructor as a way of ensuring understanding of the material. Once the question and answer sessions are complete, students take a quiz on material from the previous day. The answers to the questions are reviewed immediately after the quizzes are collected.

For the remainder of the morning, students continue lab work started on the previous day. Anatomy laboratory exercises are different from the typical science exercise. Students identify structures or tissues rather than perform experiments, therefore they can pick up where they left off on a prior day. (physiology experiments fit the norm for science lab exercises.)

Wednesday. This day progresses much like a Monday until early afternoon. At this point, students are given practical application questions that they discuss in groups. When they come to a consensus on appropriate answers, one member of the group writes those answers down and turns the sheet in for the group. The remainder of the class time for that day is devoted to questions or review.

Thursday. Students take the unit exam. Each exam consists of written and practical components. The written exam contains a mix of multiple choice, fill-in-the-blank, short answer and essay questions. The types of questions range from memory questions to concept, critical thinking and practical application questions. The practical (laboratory) component of the test consists of identifying structures and functions.

Final Exam

As a way to measure retention of knowledge, the students are given a cumulative final exam, which consists of a multiple choice section and an essay section. The essay component includes practical application, critical thinking, and "tie it all together" questions. The multiple choice component is divided into five sections, with each section corresponding to a course unit. If a student improves on an individual section of the final exam, the grade for the weekly exam is replaced by the grade achieved on that section of the final exam. This grade replacement is done only for one exam. If a student performs better on two or more final exam units, the exam unit in which the greatest improvement occurs is the grade replaced.

DISCUSSION AND CONCLUSIONS

There were a total of sixteen formal assessments over the five weeks: five quizzes, five problem-solving worksheets, five weekly exams and a final exam. Informal assessments also took place through interaction with the students. Two-thirds of the students earned higher grades on at least one section of the final exam compared to the weekly exam.

Since this was the first time Anatomy-Physiology had been run as a summer course, students were asked for input and an honest evaluation. Among the questions that they were asked were: 1) *Should the course be offered in the future as a summer course?* All students responded in the affirmative; 2) *Should the course be configured with separate lecture and lab, or integrated lecture/lab?* All students preferred the integrated approach; and 3*) Should the course run in a five week, six week, or eight week time frame?* Response was mixed, but the majority of the students preferred five or six weeks. Students liked the weekly quizzes and exams, although other types of evaluation are under consideration for future classes.

Students were asked if there was anything else that they felt would improve the course. One common response was that more time was needed for the muscle unit. Another nearly universal response was the need for more comfortable lab stools. The instructor agreed with both responses.

The instructor observed that students who were hesitant to speak as the course began were participating fully by the end of the course. Also, the quality of answers for most students improved as they discussed concepts and problems with each other.

Anatomy-Physiology I & II will be offered in future summer sessions as six-week courses. The additional week will be used to extend the muscle unit. In addition, both courses will be offered as an option during the fall semester in this integrated, compressed configuration. The issue of the lab stools is currently unresolved.

REFERENCES

Barnes, C. A. (Ed.). (1992). *New directions for community colleges--critical thinking: Educational imperative.* San Francisco: Jossey-Bass.

Bowan, S. L., (1998). *How to give it so they get it.* Tulsa, OK: Ad Graphics.

Boyle, J. (1993). PA problem solving exercise that incorporates several active learning modalities. In J. A. Modell & J. A. Michael (Eds.), *Promoting active learning in the life science classroom* (pp. 99-103). New York: New York Academy of Sciences.

Bransford, J. D., Brown, A. L., & Cocking, R. R. (Eds.). (1999). *How people learn, brain, mind, experience, and school.* Washington, D. C.: National Academy Press.

Cromwell, L. S. (1992). Assessing critical thinking. In C. A. Barnes (Ed.), *New directions for community colleges--critical thinking: Educational imperative* (pp. 37-50). San Francisco: Jossey-Bass.

Leonard, W. H. (2000). How do college students best learn science*? Journal of College Science Teaching, 29*(6), 385-388.

Modell, H. I., (1993). Why am I teaching this course? Setting educational objectives for course activities. In J. A. Modell & J. A. Michael (Eds.), *Promoting active learning in the life science classroom* (pp. 27-35). New York: New York Academy of Sciences.

Modell, H. I., & Michael, J. A., (1993). Promoting active learning in the life science classroom: defining the issues. In J. A. Modell & J. A. Michael (Eds.), *Promoting active learning in the life science classroom* (pp. 1-7). New York: New York Academy of Sciences.

Westaway, D. J., (1999). I'm teaching my heart out...of course they are learning, aren't they? In S. Cassara. & J. M. Bernard (Eds.), *Teaching for our times* (pp 11-19). Boston: Bunker Hill Community College.

TEACHING CONCEPTUAL PHYSICS THROUGH TECHNOLOGY

V. Adam Niculescu
Peter Martin
Virginia Commonwealth University

INTRODUCTION

> *Among the many new challenges facing the US physics community is the need to convince the public, and the Congress, of the excitement and the importance of what we're doing.* (Langer, 2000, p. 4)

This opinion of James Langer, the current president of the American Physics Society, mirrors many of the recent calls to revitalize the undergraduate physics curriculum. A national task force has found that physics is "...increasingly disconnected from societal needs and federal priorities" (Hilborn, 2000, p. 4). A large percentage of students switching away from science and mathematics have cited "turned off to science" as one of their reasons for changing studies (Seymour, 1995).

This problem is not restricted to the United States. A survey of pre-college students in China (Luo et al., 2000) reported that approximately 20% of the students either feared or disliked physics. One quoted comment is, "...Physics is such a subject that if you can go into it, then it is easy, but if you are unable to enter it, it will be more difficult than climbing up to the heaven."

Most physics-teaching faculty have found, or are finding, excitement in understanding physics, predicting how a system will behave, or experimentally measuring system responses. One of the needs of physics education is to convey this enthusiasm back to the students; to the post-graduate who has committed to pursue a career in science, to the physics major who may be looking for reasons to stay "turned on to science", and also to the non-science student who finds it difficult to relate physics to everyday life. Even though the latter will not be the scientist of tomorrow, s/he could be the person approving science funding, preparing media reports on the role of technology, or more likely, just part of the population that could appreciate the value of supporting science.

At Virginia Commonwealth University (VCU) the commitment to improved instruction led to the development and implementation of a new general education curriculum that stresses increased science literacy. VCU's College of Humanities and Sciences set out to create new models of college level instruction and pre-service education using multidisciplinary science courses.

In the area of physics, a new conceptual course aimed at non-science majors was developed entitled *Wonders of Technology*. The textbook, developed in conjunction with the course, was published by Wiley in 1999 and is now in its second edition (Niculescu, 2000). The approach taken in the introduction of the physical concepts was to depict their role in today's technology--specifically the technology familiar to the students--and also to emphasize the connection between technology, art and culture from the historical perspective.

COURSE STRUCTURE

Wonders of Technology is a one-semester laboratory-based course. It has a number of features.

Features of the Course

Interdisciplinary approach

Emphasis on technological and real life applications

Examples to encourage critical objective thinking

Design flexibility to allow for vertical curricular integration

Unit format stressing a project/laboratory/hands-on approach, with high student involvement

A design or discovery phase in each project requiring students to use their own results to make predictions and then to evaluate their own performance

A multimedia, highly interactive, and Web-based lecture presentation that facilitates incorporation of current technology news events

The course emphasizes the process of socializing scientific information and teaching students how to obtain additional information for life-long learning. They achieve science literacy by studying the processes, concepts, and underlying principles of modern experimental science and technology without the numbing constraint of having to obtain the exact "correct" answer. They also are required to apply the material learned in class to every-day applications, to draw conclusions from their own experimental observations and to use their own results in a design or discovery phase for each studio. Activities and tests encourage development of skills necessary to think scientifically, to understand and respond critically to science articles and programs in the popular media, and to provide some understanding of how science relates to religion, ethics, politics, economics, and the arts.

The course has a lecture component and a studio component. The studio component lasts three hours each week and is given in small sections with no more than 26 students, whereas the lecture component is given simultaneously to several sections and lasts one hour per week. By keeping the studio section size low each student receives individual attention and by necessity must contribute to the projects.

The lecture component is multimedia and interactive. At the start there is a short review of any late-breaking news from the world of science and technology. During the rest of the time the students are introduced to topics from life-related experiences, using films, demos, simulations, etc. A particularly effective method used to introduce new concepts during the lecture period is to integrate several multimedia components together. For example, when introducing the topic dealing with the effect of electric and magnetic fields on charged particles within the magneto-hydrodynamic propulsion, the sequence starts with a short movie clip, followed by a live demonstration of the magneto-hydrodynamic effect presented on the overhead projector. This is followed by a detailed explanation of the physical principles by using a PowerPoint presentation.

Topics Addressed

The topics addressed throughout the course, in the sequence presented, are:

Balance, Benefit and Doubt (the scientific method and the science of measurements)

The Nature of Things (macro- and micro-structure of materials from the perspective of product design)

The World of Light and Color (laws of optics and spectroscopic properties of light)

Bridges over Space and Time (electricity and magnetism through a communications perspective)

The Ultimate Ride (kinematics, dynamics, and hydrostatics)

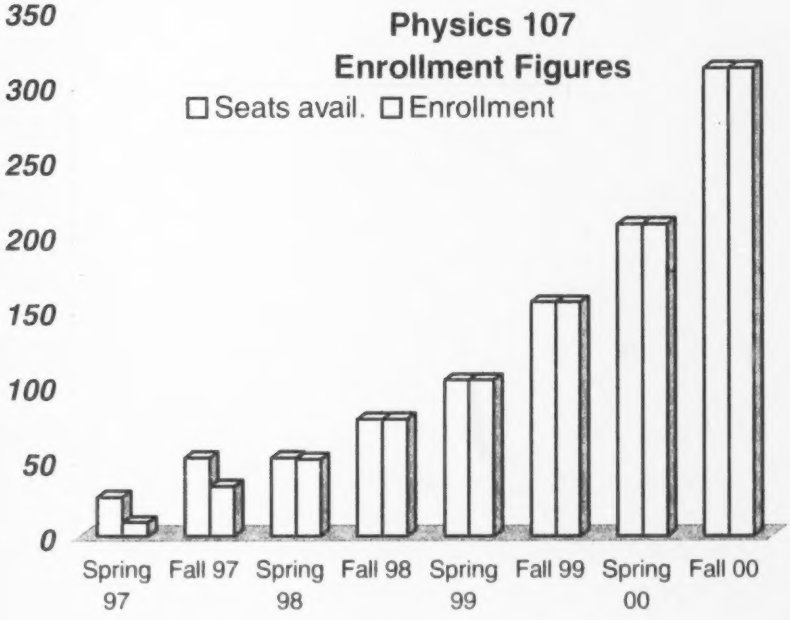
The Future is Here (latest breakthroughs in physics and technology)

Because of the smaller number of students, the studio component allows for more individual attention. The period normally starts with a short quiz covering all of the previous week's work. There is then an interactive review of the collective results from the previous weeks' project. This is followed by any instruction that is needed on the principles, or mechanics, of the project that will follow. Students work in groups of 2-4 people, on projects that have relevance to the problems raised during the lecture presentations. Cookbook quantitative experiments are avoided, process is emphasized over numerical result, conversation is encouraged, and speculation is rewarded.

DEVELOPMENT

The course was first offered on an experimental basis in spring, 1997. From this tentative start the course enrollment has grown steadily as shown in Figure 1. The number of sections has increased to 2, 3, 4, 6, 8, and currently we are offering the course to a total of 312 students distributed in 12 sections. It is significant that all the sections function at capacity and are filled long before the registration deadline. The course has seen equal enrollment by gender. Mass Communications and Business were the most common declared majors initially. Fall 1999 saw a change with Education majors having the highest percentage participation.

Figure 1. History of Physics 107 Course Enrollment



Student performance, and consequently the grade, is evaluated through a combination of project reports, self-directed projects, quizzes, homework, and a final evaluation. The final evaluation is part project and part examination. The final project is a short independent research topic, experimental, theoretical, or both, that, to the extent possible, relates technology to the student's major, or sometimes to their interests. Examples of such projects are: *Constructing a Tesla coil*, *Studying the sound frequency spectrum of different musical instruments*, *Animations of crystal growth*, *Physics of snowboarding*, and *Colored lights in stage lighting*. Overall, students consider the projects an asset to this course.

Comments made by Education majors in the evaluation of instruction have been very favorable, indicating that the content and methodology of the course would be of direct benefit to their future careers. They feel that the projects developed in the class could be used for their lesson plans when on the job as teachers.

The Virginia Coalition for Excellence in the Preparation of Teachers is a part of the National Science Foundation's project aimed at identifying and implementing "best practices" for college science and science instruction. Surveys were conducted in 1998, 1999, and 2000 to determine student assessment of the course, *Wonders of Technology*. From the students' answers we feel that to a large extent the goals and objectives are being met. As a way of improving the course, determining what the incoming students already know, and what they learn from the course, a short questionnaire is given at the start and end of the semester on topics the course covers. This has been done with both open-response and multiple-choice questions. The analyses of the data are underway.

CONCLUSIONS

The positive evaluations of the course by students, the strong recommendations given by peers and student advisors and the early filling of the course enrollment suggest the course is achieving its goals of improving the scientific literacy of the students. It appears to be showing students how physics relates to their everyday lives.

REFERENCES

Hilborn, R. C. (2000). The National Task Force on Undergraduate Physics: Some FAQs. *Forum on Education of the American Physical Society, Spring/Summer*, 4

Langer J. (2000). Media outreach programs address key challenges. *APS News, May*, 4

Luo, X., Liu, X., Fang, X., Huang, S., Liu, B., & Han, C. (2000, summer). *The "third eye" demonstration show.* Presented at American Association of Physics Teachers, University of Guelph, Canada

Niculescu V. A. (2000). *Wonders of technology*. New York: Wiley.

Seymour, E. (1995). Revisiting the "problem iceberg": Science, mathematics, and engineering students still chilled out. *Journal of College Science Teachers, May*, 392

MOVING FORWARD:
MARRYING SOUND PEDAGOGICAL CONCEPTS WITH LEARNING TECHNOLOGIES

Julie A. Richardson
Anthony E. Turner
King's College, London
Canterbury Christ Church University

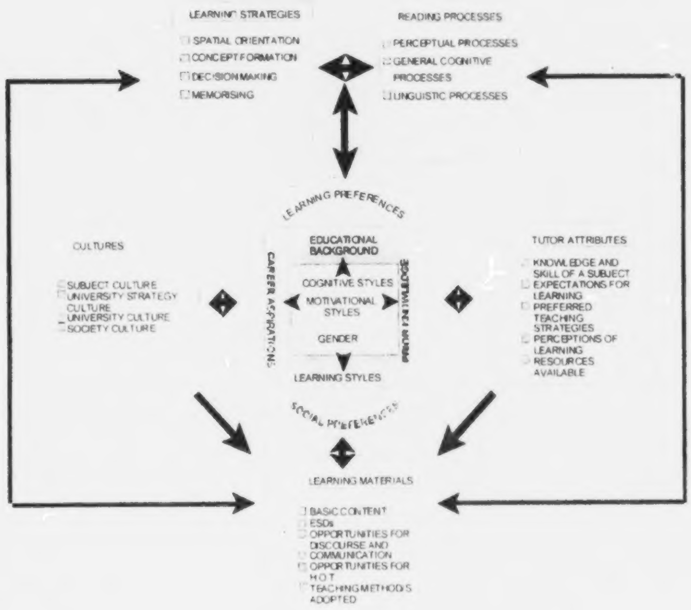
INTRODUCTION

In 1997/98, Staffordshire University introduced a Virtual Learning Environment--Lotus Learning Space--as part of its commitment to distributed learning. An ambitious and wide reaching evaluation model was then designed to appraise both the quality of students' learning and tutors' teaching experiences. This paper summarizes the results and describes two pilots implemented across two UK institutions as a result of the findings.

THE EVALUATION MODEL AND RESULTS

The project had 2 key aims: 1) to evaluate the quality of learning and teaching experiences, including the cognitive, social, and affective dimensions; and 2) To provide a model for module development and quality assurance. Fig.1 shows the final student-centered evaluation model (see Richardson & Turner, 2000 for full rationale). It emphasizes an intricate interaction between the experiences, characteristics and attitudes that students brings with them and the attributes of the "task environment" as created and supported by the tutor/ institution (Pask, 1976).

Figure 1. A Model of Learning with Virtual Learning Environments


LEARNING STRATEGIES
SPATIAL ORIENTATION
CONCEPT FORMATION
DECISION MAKING
MEMORISING
READING PROCESSES
PERCEPTUAL PROCESSES
GENERAL COGNITIVE PROCESSES
LINGUISTIC PROCESSES
LEARNING PREFERENCES
EDUCATIONAL BACKGROUND
COGNITIVE STYLES
MOTIVATIONAL STYLES
GENDER
LEARNING STYLES
CAREER ASPIRATIONS
PRIOR KNOWLEDGE
SOCIAL PREFERENCES
CULTURES
SUBJECT CULTURE
UNIVERSITY STRATEGY CULTURE
UNIVERSITY CULTURE
SOCIETY CULTURE
TUTOR ATTRIBUTES
KNOWLEDGE AND SKILL OF A SUBJECT
EXPECTATIONS FOR LEARNING
PREFERRED TEACHING STRATEGIES
PERCEPTIONS OF LEARNING
RESOURCES AVAILABLE
LEARNING MATERIALS
BASIC CONTENT
ESDs
OPPORTUNITIES FOR DISCOURSE AND
COMMUNICATION
OPPORTUNITIES FOR H.O.T.
TEACHING METHODS ADOPTED

RESULTS

The backbone of the project was a number of measuring instruments corresponding to each part of the model and fitted into, and around, the educational process during one semester. These generated a substantial amount of data which cannot be fully presented here (see Richardson & Turner 2000). However, four conclusions that formed the basis for two pilot studies are outlined below.

First, teaching has generally moved away from learner-centered to more didactic approaches with the introduction of Virtual Learning Environments. Passive strategies (e.g. content-driven, few embedded support

BEST COPY AVAILABLE

devices) meant students were highly reluctant to use them. Where cooperative, problem-based/resource-based learning is encouraged these are much better received, but tutors felt inadequately trained to do this. Second, students reported feeling less part of a learning community than previously. Third, there was an overall decrease of group activities. And finally, a range of individual differences--including cognitive style, gender and time-management skills--was found to influence the quality of the learning experience (Richardson & Turner, 2001).

In sum, two themes common through these findings became the basis for two pilot studies. First, tutors were found to need more support in bringing together valuable pedagogical principles with technology, and second, they needed guidance in facilitating on-line discussions to promote cooperative learning and a sense of community for students. Discussion, together with preliminary results, follows.

Pilot 1: Strategies For Stimulating And Maintaining Electronic Discussions

"[Learning in higher education] requires learning about descriptions of the world, knowledge derived from someone else's experience, and from understanding someone else's arguments." (McKendree et al., 1998. P.111).

> *... the discussion group? ...I think there was something at the beginning about that. Where people give their views on a topic ... and other people can reply if they want ... But no one ever uses it ... it's false ... and not much point...* (Module student)

"Asynchronous courserooms" were available in all modules for students to discuss topics with each other and their tutors. However, analyses revealed contributions lacked quality and quantity. For example, there was a strikingly low level of use by the majority of course members and an acute lack of statements evidencing higher order thinking or collaborative working. The courserooms were generally used for "housekeeping", and providing technical instructions, with little evidence of actual "discussion" comparable with a face-to-face seminar context.

The aims and pilot details are provided below.

> To improve the quantity and quality of discussion in the Virtual Learning Environment courserooms.
>
> To encourage tutors to use other means for general housekeeping issues.
>
> To improve the sense of support and community for both tutors and students.

A set of guidelines to facilitate discussions was developed. These guidelines were given to ten tutors during a workshop in which they were also shown good examples of discussions and a student resource bank to help them support and guide students. Prior to starting modules, tutors were also asked to join an on-line discussion for a two week period, facilitated by the researchers. The guidelines (Richardson, 2000) consisted of a series of 20 simple pointers to help tutors, for example, *Courseroom discussions should be linked either formally or informally with assessment arrangements and these expectations should be communicated clearly to students.*

Preliminary results suggest significant improvements in quantity and quality of contributions. Numbers of students participating have almost doubled with 90% making contributions; "reconstruction statements" (where students reconstruct a concept) have increased from 18 to 49 incidences. Positive feedback between students has increased from 14 to 39 (tutors 9 to 31). A large decrease has been found in procedural and "assumption statements" (an unjustified statement rejecting an idea). Students' initial comments have also been positive.

> *I like it because it makes us feel like we're publishing our ideas officially after we've talked about them as a team...before [in normal seminars] we often felt like our hard work had gone to waste...we seem to be working well as a group.*

Conclusions from Pilot 1. Thus far the results from this pilot are highly positive with clear improvements in quality, quantity and perceptions of experiences in courseroom discussions. Students are actively reflecting upon their studies.

Many authors support the need for this reflection. Vygotsky's ideas (1996) hinge on the idea that social interactions mediate learning. Gallimore & Tharp, (1990) suggest that small discussion groups are where students are "...drawn into unique modes of social interaction and thinking...the small discussion group is where text and personal understanding can be compared, discussed" (pp.195-197). It is essential that the fear of dialogue being "...squeezed out of the formal education system, particularly higher education...because of the growing emphasis on the use of educational technology" (McKendree et al., 1998, p.113) isn't realized. With a simple set of guidelines and training, tutors have made significant leaps to reintroduce dialogue as a key component of student learning.

Pilot 2: Training School-based Curriculum Development Advisors--A Model For Staff Development

> *This has been the worst thing that's happened to me and the best...talk about being thrown in the deep end.... Really I mean technologically....(Tutors comment)*

Results showed there were few attempts to adopt principles of cooperative learning and resource based learning. Rather, materials encouraged passive participation often of an administrative nature, or reflected pages of a textbook with little opportunities for higher order thinking and collaboration. A chief constraint was lack of tutor expertise and support available to them, particularly within their own departments. As these comments highlight:

> *We need more help with this. it's only now I realize how this makes you review what you are trying to do in courses...*
>
> *[learning development] has helped as much as they can ..*
>
> *they're busy, I'm busy and trying to find time is difficult.*

A pilot was designed to provide a stronger school-based infrastructure of support for tutors embarking on modules for on-line learning. The current central system of support was clearly not sufficient for the enormity of the task required of staff. Cross-university discussions agreed to advertise for applicants to take part in a scheme to bridge schools with learning development. Figure 2 summarizes the Curriculum Development Advisor role.

Figure 2. School-based Curriculum Development Advisor

Selection, Preparation and Training...

- Applications utilized from Learning and Teaching Fellowship scheme
- Attend regular short courses with the opportunity to build a portfolio of professional development to obtain an accredited certifcate
    - Cooperative learning
    - Evaluating student learning and VLEs
    - Using student feedback
    - Planning for individual differences
    - Different models of teaching and learning for VLEs
    - Mentoring and supporting colleagues

Features of the role...

- Interdisplinary elements
- Resources co-ordination
- Subject specialist support
- Technical Support
- Promotion and support in quality assurance
- Mentoring
- Dissemination

Job specification...

- Individual tutor mentoring
- Department boards
- School board committees
- Quality Assurance Committe
- University Learning & Teaching Committee

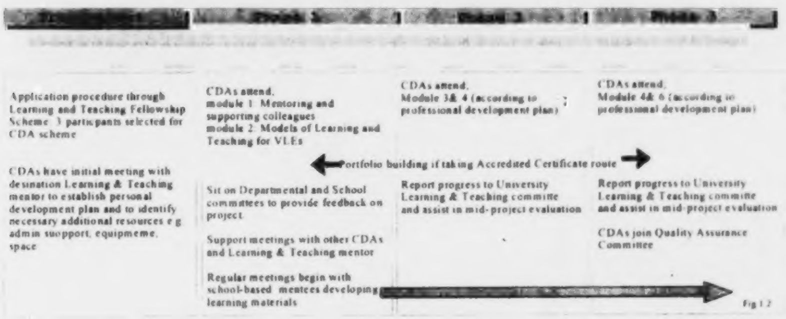
CDAs are supported by...

- Learning Development staff/mentors
- Technical Support Officers
- Job release scheme
- Ongoing needs analysis
- Regularly training/support short courses

Ten Curriculum Development Advisors were released from teaching duties two days a week to support staff within their schools and to join six short courses centered on learning and teaching methods appropriate for Virtual Learning Environments. The aim was to train advisors to promote good practice in the production of learning materials for virtual learning environments. Sub-aims included: 1) to provide staff with better support in developing modules for Virtual Learning Environments; and 2) to raise awareness of pedagogical issues and facilitate the adoption of cooperative, collaborative, problem-based and resource-based learning.

The scheme comprised three strands running through several phases over 12-months (Figure 3).

Figure 3. Project Time-Plan for School-Based Curriculum Development Advisors



Application procedure through Learning and Teaching Fellowship Scheme. 3 participants selected for CDA scheme

CDAs have initial meeting with desination Learning & Teaching mentor to establish personal development plan and to identify necessary additional resources e g admin suopport, equipmeme, space

CDAs attend,
module 1: Mentoring and supporting colleagues
module 2: Models of Learning and Teaching for VLEs

CDAs attend,
Module 3& 4 (according to professional development plan)

CDAs attend,
Module 4& 6 (according to professional development plan)

Portfolio building if taking Accredited Certificate route

Sit on Departmental and School committees to provide feedback on project

Support meetings with other CDAs and Learning & Teaching mentor

Regular meetings begin with school-based mentees developing learning materials

Report progress to University Learning & Teaching committe and assist in mid-project evaluation

Report progress to University Learning & Teaching committe and assist in mid-project evaluation

CDAs join Quality Assurance Committee

First, training strand-advisors attended short courses designed with the option of also attaining an accredited Certificate in Higher and Professional Education. Each advisor was appointed a mentor in learning developments, which were one of two senior lecturers of learning development. These individuals met regularly.

Prior to their school-based work, advisors attended the "Mentoring Colleagues" course to help them through the second, mentoring strand where tutors were appointed to the advisors. Individuals either approached Curriculum Development Advisors or were allocated to an Advisor (average 12 per Advisor over 2 semesters).

The third institutional strand was intended to involve the Advisors within school and cross-university discussions in the area of developing good practice in Virtual Learning Environments. These forums provided committees with feedback regarding the scheme and also provided the opportunity for Advisors to make cases for additional resources for their mentees .

Preliminary Results--Interviews. During the course of 12 months, Advisors and tutors were invited to attend in-depth interviews three times--during phase one, two and three. Five themes emerged, including: *My overall perceptions of Virtual Learning Environments; My own personal and professional development;* and *My goals have changed.* A limitation of space prevents a full report of

BEST COPY AVAILABLE

these themes; however, the following quotations reflect the change of attitude by module tutors:

> *You... don't realize what things you should be taking into account when you design materials.... you have to do more than go for the "average" student--its fascinating...*

> *Normal staff development feels like a "guru" coming in and telling you how to suck eggs. I like the "tea-trolley support". When I'm, well not even stuck, I can stop him [the Advisor] and say what do you reckon about this.... its brilliant. ..no hassle*

Thus the tutor participants so far have been overwhelmingly supportive of the scheme. The Advisors themselves have also found the experience extremely hard work but enjoyable and worthwhile. For example:

> *...I think within the school we've pulled together more... I've changed so much over the last year and feel as if I can give much better advice now than I could a year ago...*

> *I'm doing something worthwhile, [the tutors] feel they are being valued and getting something from this...generally it doesn't feel like it's being imposed from the top down and it's sink or swim. ...Partnership...I suppose that's what it feels like now.*

Materials analyses also reflect significant attempts to place the learner at the center. Four out of five modules have adopted a cooperative learning approach. Two of these accompanied resource-based learning. Two others accompanied a linear approach but with some branches to resources. Only one module adopted a linear approach with very little collaborative activity. There were significant increases in the provision of supporting resources, questions and activities to test mastery, activities, summaries, collaborative tasks and advance organizers.

Conclusions From Pilot 2. This pilot has successfully adopted a scheme of achieving staff development on a range of levels and through a proactive model. As Doughty (1996) emphasized, "Information technology (IT) can make teaching and learning more effective...But you need to invest in its physical and organizational infrastructure..., and in integrating IT into the students learning" (p.1). Although the Curriculum Development Advisor scheme is young it appears to be a valuable tool for promoting a stronger, self-propelling community better able to use learning technology.

Staff report benefits both professionally and personally from being involved in project work. They are refreshed by the opportunity of pursuing learning and teaching issues directly relevant to their own and colleagues' teaching and to see their work in the broader context and to exchange ideas with colleagues beyond their own department and courses. The Curriculum Development Advisors make a significant contribution towards an institutional culture of cooperation and shared goals and the development of its staff.

CONCLUSIONS

// This paper has described two pilot studies designed to support and guide tutors in their tasks of developing quality learning materials for use on-line. The quality of teaching and learning has generally improved and tutors report feeling more positive about their work. Both pilots report positive feedback from students.

Woods (1990) reports teachers gradually lose a sense of creativity in their teaching and generally fail to develop. Here Tutors have engaged in reflective and developmental practice through both partnership and research (Schon, 1983). The results are encouraging enough to suggest that there is great potential for developing both schemes further. It is hoped that in time both will expand as more and more tutors become experienced and familiar with the processes involved in both pilot studies.

REFERENCES

Doughty, G. (1996, April). *IT in education and education in IT.* Paper presented at Ensuring National Competitiveness in the Information Economy, Jakarta, Indonesia.

Gallimore, R., & Tharp, R. (1990). Teaching mind in society: Teaching schooling and literate discourse. In L. C. Moll (Ed.), *Vygotsky and education: Instructional implications and applications of sociohistorical psychology* (pp.175-205). Cambridge, U. K.: Cambridge University Press.

McKendree, J., Stenning, K., Mayes, T., Lee, J. & Cox, R. (1998) Why observing a dialogue may benefit learning. *Journal of Computer Assisted Learning, 14*, 110-119

Pask, G. (1976). Styles and strategies of learning. *British Journal of Educational Psychology, 46*, 128-148

Richardson, J. A. (1999). *A large-scale local evaluation of students' learning experiences using virtual learning environments: rationale and project guidelines.* Staffordshire, U. K.: Learning Development Centre, Staffordshire University.

Richardson, J.A. (2000) *Developing collaboration in the courseroom.* Manuscript submitted for publication.

Richardson, J. A., & Turner, A. E. (2000). A large-scale local evaluation of students learning experiences using VLEs. *Educational Technology and Society, 3*(4), 108-125. [On-line]. Available: http://ifets.ieee.org/periodical/vol_4_2000/v_4_2000.html

Richardson, J. A., & Turner, A. E. (2001, July). *An evaluation of virtual learning environments and their learners: An empirical evaluation of the interaction between individual differences and new learning technologies.* Paper to be presented at European Learning Styles Information Network Conference, Cardiff, Wales.

Schon, D. A. (1983). *The reflective practitioner: How professionals think in action.* London: Temple Smith.

Vygotsky, L. (1996). *Thought and language.* Cambridge, MA: MIT Press.

Woods, P. (1990). Social aspects of teacher creativity. In P. Woods (Ed.), *Insights into teachers' thinking and practice* (pp.298-312). London : Falmer Press.

THE PEDAGOGY OF ON-LINE INSTRUCTION IN LABORATORY SCIENCE

Larry Spears
John A. Logan Community College

INTRODUCTION

The question of a laboratory science course taught through the Internet has been something of an oxymoron for several decades. A great many studies have indicated that in terms of canonical content Internet students do as well if not better than in-class students (Vachris, 1997). While the early consensus in this field was that only certain types of learning objectives would be appropriate for this medium (Redding & Rotzien, 1999), nursing students who had been taught on-line had significantly higher scores on two measures of socialization than did campus-based nursing students (Nesler & Hanner, in press).

Some discussions about Internet education become borderline incoherent, calling Internet learning "a means to an end." (Trinkle, 1999, p. A60). There are clearly two very different concepts at work here, not always separated in the literature. The purpose of this study is to begin to distinguish between canonical learning and results like those of Nesler & Hanner (in press) which imply the attainment in distance learning courses of so-called "process skills". These skills are at the core of the discussion about teaching laboratory science on the Internet. This study presents a new, practical pedagogy for determining which laboratory activities can be successfully moved to the World Wide Web.

METHOD

Participants

The final examination scores of seventy-six college students were used in this study. These students completed a one-semester General Biology for Non-Science Majors survey course.

Test scores from four sections over four years of this multi-section course were used to compare on-line with in-class achievement. Only the numerical score of each comprehensive and objective final examination was used, and no record was kept of any student by name.

Materials

Eighteen students were enrolled and completed a new on-line Section of *Biology for Non-Science Majors* during the Summer semester, 2000. There are normally seven to eight on campus sections of this course in the Summer and fifteen to sixteen sections in both the Fall and Spring semesters. Instruction in the Internet section centered on a Web site managed by the instructor. The Web site contained instructor-created timed examinations, hyperlinks to relevant Web sites and a chat room for students with instructor-created group discussion questions. The instructor also developed and posted "Web Laboratories" which the students completed off campus.

Private communications between students and between student and instructor were accomplished through personal e-mail accounts. The textual material of the course was contained in four commercially prepared CD ROMS that were accessed with "player programs" downloaded by the student from the Web site. For some material, the instructor edited the player programs, thus modifying the textual CD ROMS prior to student use. The general goal was to organize the Internet section to match the learning objectives of the on campus sections.

Design and Procedure

Students enrolled in the Internet section were required to be on-campus for two days during the term, one day near the midterm of the course and one during finals' week. These "Residence Days" were for the completion of laboratories not suitable for the Web and to complete on-campus a midterm, a final examination, and a laboratory final examination.

Students were also assessed by four on-line, timed hour examinations as well as numerous "Discussion Questions", "Web Quests," and "Web Laboratories." Web Laboratories were created by following a new rule for distance learning laboratory activities.

> English Rule (Spears Version).
>
> *If the educational event requires the manipulation of objects and materials that cannot be accomplished outside the science laboratory, then that event must occur in the laboratory.*

The sanction of the "English Rule" appears simple but it is quite subtle and is meant to be mandatory--if the event can occur outside the on-campus laboratory, it must. Further, the objective event now controls what must be done in the laboratory and not vague idealizations about the laboratory educational experience. In this particular case, a number of events were deemed not acceptable as Internet learning activities--the use of the compound microscope, Microbiology, dissection of the crayfish, and dissection of the frog. These learning activities were completed on campus during Residence Days.

Other laboratories, such as the classical study of mitosis, were placed on the Internet. A posted laboratory handout was combined with hyperlinks to interactive tutorials (e.g., Biology Project, 2000) as well as on-line photomicrographs of the white fish blastulae and onion root tip cells. The student completed what amounted to an expanded laboratory report off campus and turned it at the next Residence Day.

RESULTS

Raw data from the final examinations of four sections of this course were analyzed using both a one-way ANOVA and the non-parametric method of Rank-Sum Statistics of Kruskal-Wallis.

These sections included one from a colleague of the author and three of the author's from different years, chosen randomly. *Scores listed in Table 1 do not represent scores from identical final examinations. All that was common between the sections were that the tests were comprehensive, objective, and based on an identical course syllabus.* The only variation is that the Internet section used the English Rule to determine the pedagogy of the required laboratory activities.

Table 1. Raw Examination Scores

Section A - Harris - In-Class - Summer 2000																							
Section B - Spears - In-Class - Fall 1998																							
Section C - Spears - Internet - Summer 2000																							
Section D - Spears - In-Class - Fall - 1996																							
A	57	64	68	69	71	75	77	81	81	83	84	84	87	89	89	91	92	92	93	96	97	99	10
B	60	61	61	61	61	66	67	68	71	72	76	78	78	79	80	83	87	91	95	99			
C	55	59	61	63	67	74	75	75	77	77	78	81	82	87	89	91	99						
D	67	69	70	72	72	74	74	79	81	88	91	91											

The null hypothesis of an ANOVA is that the means of the four samples are the same. This implies that within the alpha significance level we cannot tell the difference between the four sections. The null hypothesis was not rejected at a significance level of .05, F(3, 72)= 2.13, < 2.712 (e.g. Ogden & West, 2000). See Table 2.

Table 2. Analysis of Variance

Source	df	SS	MS	Fstat	Pval
Treatments	3	863.99854	287.9995	2.1300912	0.1039
Error	72	9734.777	135.20525		
Total	75	10598.776			

The Kruskal-Wallis H factor is a nonparametric test for the significance of the difference among distributions of independent samples (e.g. Lowry, 2000).

Non-parametric tests do not use the numerical value of the test but only the relative ranks of the different tests. This test is somewhat more general than an ANOVA since it does not require that the general population be normal. To *not* reject the identical null hypothesis, the H statistic must be less than the relevant Chi-Squared value. See Table 3.

Table 3. Kruskal-Wallis Test
Mean Ranks for Samples

A	B	C	D
48.1	33.1	34.8	34.8

df = 3, N =72, H = 6.71

At an alpha level of .05, H= 6.71 < 7.815 (Critical Value of Chi-Squared for df =3, N=72). Tie scores were corrected by (.9981) adjusting H to 6.723, still much less than 7.815.

CONCLUSIONS

The implication of this study is that the scores in the four sections have been taken randomly from the same continuous population: i.e., the comprehensive and objective final examination scores of those students that have completed *Biology for Non-Science Majors*. Moving a number of laboratory learning activities to the Internet did not refute either null hypothesis.

Without any time constraint, the Web laboratory experience could be more open ended and creative compared with its in-class counterpart. In general, laboratory tasks placed on the Web using the English Rule appeared after the fact to correlate closely with learning objectives also emphasized in the traditional lecture. Those educational activities that only appeared in the laboratory were more likely not to satisfy the rule. Further research is needed to examine this correlation between acceptable Internet laboratories and those that could not be moved.

Traditional laboratories originally came into being to model for the student "after graduation behavior." The Web laboratories of this study selected using the English Rule were completed to reflect the new Internet workplace which will be "at a distance" and asynchronous. This new laboratory pedagogy clearly had no significant statistical effect on traditional final examination scores.

REFERENCES

Biology Project. (2000). University of Arizona. [On-line] Available: http://www.biology.arizona.edu

Lowry, R. (2000). *VassarStats: Web site for statistical computation.* [On-line]. Available: http://faculty.vassar.edu/ %7Elowry/VassarStats.html

Nesler, M. S., & Hanner, M. B (in press). Professional socialization of baccalaureate nursing students: Can students in distance nursing programs become socialized? *Journal of Nursing Education.*

Ogden, R. T., & West, R. W. (2,000). *Webstat 2.0.* [On-line]. Available: http://www.stat.sc.edu/Webstat.

Redding, T. R., & Rotzien, J. (1999). *Comparative analysis of SDL online training with traditional classroom instruction.* 14th International Symposium on Self-Directed Learning.

Trinkle, D. A. (1999). Distance education: A means to an end, no more, no less. *The Chronicle of Higher Education, August 6,* A60.

Vachris, M. A. (1997). Teaching economics in a virtual classroom. *Virginia Economic Journal, Sept.* 17-26 .

LABORATORY FOR INCORPORATING COMPUTER SCIENCE THEORY WITH REAL-WORLD INTERESTS AND DIFFICULTIES

Carl W. Steidley
R. Stephen Dannelly
Texas A&M University – Corpus Christi

INTRODUCTION

This paper describes a versatile and innovative active learning laboratory called the Real-Time Lab, supported by a National Science Foundation CCLI Program grant (DUE-9950839), that is used to teach a wide variety of computer science and mathematics subjects. The laboratory enables the authors to transform a wide range of computer science algorithms and abstract concepts into physical realities. This paper briefly describes the laboratory hardware and gives and overview of an incrementally complex series of assignments supported by the laboratory.

BACKGROUND

Computer Science 4348, *Systems Programming*, is a three hour senior level course which addresses the design and implementation of systems software such as application support libraries and interprocess communication facilities. This course has a particularly strong emphasis on software writing and addresses low-level software development. Prior to funding for this project, students enrolled in this course developed software using a network of DEC workstations. Assignments included logging user activity over a network, simple interprocess communication between Unix machines, use of semaphores to control shared resources and an extensive client-server development project.

Dannelly (2000) observed that the effectiveness of this type of course can be greatly improved by placing it in a setting where students can actively extend the concepts being taught into tangible realities. The authors therefore began building a new laboratory equipped with a model railroad system, five networked Linux-based control computers and two ActivMedia Pioneer class autonomous mobile robots.

A model railroad was selected for a number of reasons. First, both discrete-state (modeled by state machines or Petri nets) and continuous-state (described by transfer functions) control problems can be modeled. Second, a sensor-instrumented model railroad is versatile and enables students to work on a large variety of potential projects. Third, it is not difficult to obtain the necessary equipment. Fourth, it is virtually impossible to think of a more inexpensive option with the same capabilities. And finally, it was believed that the model railroad would stimulate interest throughout the campus and the local community. Steidley (1996) found that students are enthusiastic about a course that will teach them to use the computer to control a model railroad.

The ActivMedia Pioneer mobile robots were selected as the robotic platform for the laboratory for several reasons. First, it is a sturdy, proven platform. Second, the robot control software runs a reactive planning system with a fuzzy controller, behavior sequencer, and deliberative planner, all of which are easily interfaced with the C programming language. Third, it has seven sonar transducers to provide object detection, range information and feature recognition. Fourth, it has an optional versatile, high-performance vision system. And last, each of its drive motors includes a high-resolution encoder for precise position sensing.

Railroad Setup

The model railroad system has two main parts--the track bed and the control/development computer network. The track bed is composed of approximately 100 linear feet of HO scale track with 30 electronically controlled track switches called turnouts. Sensors were placed every three inches along the tracks. These sensors only detect the presence of an object, not the type of train car, nor its speed. These components rest on half-inch paperboard that is fixed to a 30-inch high, six foot by eight foot table constructed of plywood. All track, turnouts, and sensors were purchased off-the-self.

Control And Development Computer Network

Five Pentium III PCs are used for software development and testing. These Linux-based computers are attached to the campus LAN and hence the Internet. This will allow students to use the system from anywhere. One computer is equipped with an electronic signaling device known as a "throttle" that controls all components of the track system. This main control computer is equipped with the A/D card that supplies location sensor data. In addition to the computer-controlled track system, four low-cost cameras are being installed. Each camera will be fixed in place to provide different views of the system via the Internet. One camera will overview the entire trackbed, while two others will provide close up views of key track portions. The fourth camera will focus on the model crane.

Robots

The robots will be used in support of the artificial intelligence course for the purposes of offering a unifying theme that draws together the disparate topics of artificial intelligence. They will serve to focus the course syllabus on the role artificial intelligence plays in the core computer science curriculum as well as to motivate students to learn by using concrete, hands-on laboratory exercises.

In addition to the many standard problems that can be assigned in advanced courses such as artificial intelligence, the authors have begun to use robots in lower-division courses. For example, robots have been used in the sophomore-level data structures course. Kumar & Meeden (1998) found that, with the appropriate introduction, the use of such manipulables promotes retention and turns abstract concepts into real-world problems and solutions.

SAMPLE RAILROAD ASSIGNMENTS

The initial assignments that use the model railroad system asks students to create libraries to allow easy control of train speed and direction, control of turnouts, and access to location sensor data. This requires the students to create several device drivers. These libraries are then used by the Systems Programming students to create a server process that communicates requests to both the throttle and sensor A/D card.

A student project that was assigned in a course covering the X Window System required each student to create a graphical user interface to display the current status of the system, control train speed and direction and control each turnout. This required the use of the C library routines and device drivers written by earlier Systems Programming students to determine both the number of trains on the track and their lengths. Effectively displaying this wide array of information in real-time presented an exciting challenge to the students. Effective interfaces will be used by later projects.

A very interesting problem to be tackled by either the Systems Programming or an Operating Systems course will be to create an application that can run on each of the five computers so that each computer shares the turnouts and simultaneously controls a different train. This distributed resource control problem is a classic operating systems theory problem that will be presented, literally, in front of the students' eyes.

Students will be expected to derive a centralized control solution where one computer serves as a gatekeeper and each application makes requests for turnout changes to that one gatekeeper. They will also be expected to derive a distributed control solution in which each application shares equally in the decision making as to which application may control the shared resources of track space and turnout direction. Of course, this classic problem has many algorithmic solutions which students can implement and view the tangible results.

A problem requiring students to draw heavily on their mathematics background is to move a train at proportional speed. Of course, a model train can start and stop very quickly, whereas real trains start and stop slowly. The objective of such an assignment would be to create mathematical formulas to determine scaled acceleration and deceleration. A challenging problem for an artificial intelligence course will be to have an application automatically move a single train from one point on the track to another point with the minimum number of changes to turnouts. In other words, implement a version of the traveling salesman problem.

Building on the previous problem, the authors plan to have students design, implement and test algorithms to have one application automatically move a train from point A to point B, while a separate application simultaneously moves a different train from point C to point D. Two possible versions of this problem are apparent. First, both applications may be running on a single machine allowing the shared resources to be controlled via semaphores. Second, each application may be running on separate machines, requiring one of the distributed control methods described above.

Continuing this natural progression of theoretical problems, an assignment to be solved by students enrolled in either the Operating Systems or the Systems Programming courses will be to detect deadlock. Detecting when one train occupies track portion 15 and is requesting track portion 20, while another train occupies track portion 20 and is requesting 15 will be an interesting problem. Once again, the Real-Time Lab will facilitate the detection of deadlock in both a distributed and centralized environment.

SAMPLE ROBOT ASSIGNMENTS

The first law for many robot projects can be stated as "move about and don't get stuck." Jones et al. (1999) describe a series of introductory robotic projects, the first of which is as described in the previous sentence. They call this project, "The Lewis and Clark" project. The authors use this and variations of several other projects described by Jones in which students are required to incrementally incorporate the sensor suite of the robots. These projects have names such as *Mouse*, where students are required to program the robots to follow walls; *Magellan*, where students are required to program the robots to navigate a closed path; *Apollo 13*, where students are required to program the robots to home in on a single bright light source; and *Fire!*, where robots are programmed to traverse a maze and extinguish a lit candle placed somewhere in the maze (see www.trincoll.edu/~robot/ for a description of the Fire Fighting Home Robot Contest).

CONCLUSIONS

The authors view the Real-Time Lab as a highly effective means of turning abstract ideas into firm realities while exciting the interests of students. This inexpensive system supports the teaching of a vast array of computer science concepts. Asoodeh & Steidley (1996) found that involving science students in "real-life" challenging problems in a setting that they find interesting promotes retention and aids in recruitment. While this paper has introduced the hardware design and overviewed numerous potential projects, more information concerning the Real-Time Lab can be found at www.sci.tamucc.edu/trainlab.

REFERENCES

Asoodeh, M. M., & Steidley, C. (1996) *Developing an interdisciplinary computer science/industrial technology laboratory*. Proceedings of the 1996 Annual Conference of the Gulf-Southwest Section Conference of the American Society for Engineering Education (pp. 366-370).

Dannelly, R. S. (2000). Use of a mobile robot in a data structures course. *The Journal of Computing in Small Colleges, 15*(3), 85-90.

Jones, J. L., Flynn A. M., & Seiger B. A. (1999). *Mobile robots: Inspiration to implementation*. Natick, MA: A.K. Peters.

Kumar, D., & Meeden, L. (1998). A robot laboratory for teaching artificial intelligence. *SIGCSE Bulletin, 30*(1), 341-344.

Steidley, C. (1996) A laboratory for real-time software systems development. *Computers in Education Journal, VI*(2), 10-14.

UNFETTERED FRENCH: LEARNING ONLINE WITHOUT THE BOUNDS OF SPACE OR TIME

Katherine Watson
Coastline Community College

INTRODUCTION

Naysayers claim that foreign languages cannot be learned online; Washington Post reporter Jay Mathews (2000) has gone so far as to have claimed, based on his own experience, "online learning is to real learning as video games are to war." (p. 17). But as Swaffar et al. (1998), Chun (1998), Sullivan & Pratt (1996), and Kramsch (1983) have noted, the discourse management and strategic capacities demanded in online coursework lead to the kinds of improvements in critical thinking and in writing that underlie communicative competence. And such competence, which defines the intermediate- and/or advanced-level learner, according to the American Council for the Teaching of Foreign Languages is attainable online in an extraordinarily fast, complete, and natural fashion (American Council for the Teaching of Foreign Languages, 1985). Online learners may achieve a level of mutual comprehensibility with native speakers in an astonishing variety of contexts.

DESCRIPTION OF THE STUDY

Twenty adults ranging in age from nineteen to eighty-six participated in an online French fluency improvement course during two eighteen-week semesters at Coastline Community College in Fountain Valley, California. Each student had studied French for at least two college semesters prior to their enrollment in the course; not all students had learned how to use the online networks or course technology available to help them learn. Among the learning materials and environments offered were e-mail among colleagues and with their instructor, synchronous electronic online chat for as many as twelve hours a week, an asynchronous communication area, a "Website of the week" with an associated critical thinking question, and myriad French hyperlinks embedded in their course material questions. The questions used the French in Action video lesson series as their springboard.

In addition, Coastline students were provided with native French-speaking correspondents, who were also invited to participate in course activity. Students were encouraged to involve themselves in all areas of the course but were given no specific due dates or deadlines; they were told to proceed at their own pace and to do assignments in any order they wished. All their communication was to be performed in French. Writings were scored holistically, and short online quizzes were scored with testing software.

FINDINGS

As Chun (1998) and Sullivan & Pratt (1996) have observed, students learn best online who participate most in the asynchronous and synchronous communication opportunities and environments offered them. Chun indicated that her introductory German language students began to make the best progress after more than eight interactions with others in a synchronous online chat session lasting for twenty-five minutes. The four students in Coastline's "French Topics" course who made the most progress in their French fluency are those who entered online chat rooms for more than an hour a week for at least nine weeks of each eighteen-week semester. These same students participated in asynchronous communication via e-mail and the course bulletin board on a weekly basis.

The six students who participated in chat sessions weekly but who submitted only bi- or tri-weekly e-mail and bulletin board messages in French achieved the American Council for the Teaching of Foreign Languages "intermediate speaker" proficiency level but not the "intermediate writer" level that the four more active ones did. That is, while all ten developed the ability to ask and answer questions and to initiate and sustain basic communication tasks with ordinary conversational strategies, it was only the four most active students who seemed to feel freely creative in their writing, describing and narrating in both the present and the past and using compound and complex utterances as well as embedded questions.

A third group of five participants entered the chats very occasionally, less than thirty percent of the time they were offered, and they wrote e-mail messages and bulletin board entries fewer than six times in each semester. These learners did manage to achieve certain of the American Council for the Teaching of Foreign Languages intermediate-level proficiencies even with this relatively limited participation. That is, they managed to ask and answer questions both synchronously and asynchronously in French, and they were able to narrate and describe in connected discourse.

Finally, five members of the class were very rarely communicative. Two of them cited technical problems as their major frustration, without specifying whether the problems were their own or the College's, and three of them cited the "overwhelming" nature of the vast array of course material available as being either threatening or intimidating.

In sum, it was clear that the students who participated most developed their fluency the most; moreover, these were also the ones whose writing included the most varying sentence types and subject matters. That is, as participation increased, sentence variety also increased. Complex sentences, subjunctive verb forms and specialized vocabulary entered into learners' writing as their writing began to explore more diverse semantic contexts.

In addition, it should be noted that all except the very least active Coastline students began after only two or three communications to develop the same kinds of sentence patterns and grammatical errors as the native French speakers exhibited in their electronic communication. Writing mistakes were of a surface-level nature homophonous with the correct forms; deep-structure errors were few.

CONCLUSIONS AND RECOMMENDATIONS

The online environment can offer "much besides book-learning" that Teddy Roosevelt (1913) thought necessary to make "education…really good." (p. 35). The Coastline French students have all remarked that their course has offered them vocabulary and ideas to think/write about that they had never conceived possible in an ordinary, context-restricted language class.

But as the Washington Post's Mathews (2000) pointed out, online learning should not be conceived of as a replacement for other forms of learning. Internet-assisted learning will be most successful if certain technical and humanistic details are considered. If cyberspace is to serve as a useful delivery medium, then technical support must be continuous and easily accessible to both instructor and students twenty-four hours a day, seven days a week.

All twenty students participating in this project found that Coastline College's technical support was irregular, if not entirely lacking, when they needed it. Students who attempted to use Coastline's own facilities to perform their coursework often found that, as French students not enrolled in regular "tech" courses, they were not permitted computer access.

The instructor was allowed to use College computers for only limited hours on occasional days; for the most part, she was expected to create course materials on her own time with her own equipment. Comfort and a sense of inclusion are essential to the learning of a new language, especially through a new medium; one must not feel isolated, not like an anonymous numbers.

Neither should one feel at all threatened or intimidated. Although they are "distant learners", online students should not be assumed to be entirely independent. A Web-based course in French should not look just like a business management or a math course, but it should not be unrecognizably distinct from everything else offered by their institution, either.

Form letters and templates that may help the college or its staff to manage the course should be alterable by the instructor of the subject in question. If the college finds it essential to have materials mirror one another, they may need to be mirrored in parallel texts for foreign language students. Language learners' attention will automatically gravitate toward words and forms they recognize and fail to attend to the new, the foreign, that they are supposed to be learning.

Course enrollment and site navigation should be made simple for students; Coastline distant learners complain regularly that they cannot enroll online for online courses. Neither has the College yet made it simple for truly "distant" learners to enroll; the French-speaking correspondents invited to this class to chat/write in their native language with American learners were not able to enroll because of exorbitant fees demanded from non-locals. Learners from Burundi or Madagascar could not possibly afford to pay for a course that would cost them a year's income. But these learners should be encouraged to join the Coastliners, if only for the scientific interest that the similarity of their linguistic patterns to those of the Coastliners may provide. Online learning tools such as those recently made available at Virginia Tech (2000) with the student in mind might be useful; adult students especially should be made comfortable in a world where their children may be more at ease than they are.

Adults learning online must be encouraged to interact freely if their progress is to be real and enduring. This can be possible even in the transitory world of cyberspace.

REFERENCES

American Council for the Teaching of Foreign Languages. (1985). *ACTFL proficiency guidelines* (revised). Hastings-on-Hudson, NY: ACTFL Materials Center.

Brown, H. D. (1994). *Principles of language learning and teaching* (third edition). Englewood Cliffs, NJ: Prentice-Hall Regents.

Chun, D. (1998). Using computer-assisted class discussion to facilitate the acquisition of interactive competence. In J. Swaffar, et al. (Eds.), *Language learning online: Theory and practice in the ESL and L2 computer classroom* (pp.57-80). Austin, TX: Daedalus.

Kramsch, C. J. (1983). Interaction in the classroom: Learning to negotiate roles and meanings. *Die Unterrichtspraxis 16*(2), 175-190.

Mathews, J. (2000). Net gain. *The Washington Post,* Oct. 15, 2000, W18. [On-line]. Available: http://www.washingtonpost.com

Roosevelt, T. (1913). *History as literature.* New York: Charles Scribner's Sons.

Sullivan, N., & Pratt, E. (1996). A comparative study of two ESL writing environments: A computer-assisted classroom and a traditional oral classroom. *System, 29*(4), 491-501.

Swaffar, J., Romano, S., & Arens, K. (1998). *Language learning online: Theory and practice in the ESL and L2 computer classroom.* Austin, TX: Daedalus.

Virginia Tech. (2000). *Online education and the virtual university forum.* [On-line]. Available: http://www2.cddc.vt.edu/vu/article.php?topic=edtech

CAUGHT UP IN THE WEB -- WHO NEEDS PROFESSORS, IT'S ALL ON THE NET

Peter W. Wright
University of Alberta, Canada

INTRODUCTION

Alternative delivery

The term alternative delivery can be used to represent almost any approach to instruction which differs significantly from traditional approaches (i.e. those that are typified by a group of learners receiving instruction by expository methods). For example, the use of Computer Assisted Instruction in the learning of mathematics or the use of Computer Assisted Interactive Videodisc technology to enhance the understanding of kinematics (Wright & Pasek, 1997) are contemporary, classroom-based examples of alternative delivery.

Distance education, an evolution of learning-by-mail, is an important subset of alternative delivery. Over the course of time many developments and innovations have been introduced into distance education, including the use of television, audio conferencing and fax technology. Despite these approaches, early attempts at distance education were largely unsuccessful, particularly if judged by student success/completion rates. More recently, computer technology has been introduced into the distance education equation. While computers have continued to become faster and more powerful, by far the most significant developments in the last decade have occurred in the communications area. In particular, these developments have given rise to the Internet and through it, the World Wide Web.

Interest in the Internet and related technologies has grown at a phenomenal rate. Much more than a communications vehicle because of the technologies that it can connect, the Internet is seen as having enormous potential in education. Not only does it promise to impact the general teaching/learning paradigm, it will almost certainly redefine alternative delivery. This is evidenced by the emergence of virtual schools and opportunities for online learning. Common reasons for choosing online learning include:

Geographical barriers to attending conventional classes

Access to programs or courses that are not available locally (or on-site)

Conflict with the social or religious values of an educational institution

Preference for home-based learning

Reasons relating to health or physical ability

Conflict with other responsibilities or commitments (e.g., employment)

Preferences relating to the pace of learning

Preferences relating to learning style

At first glance, these reasons might not seem to differ from those that would have applied to earlier implementations of distance education. However, the fact that most of them are now underpinned by electronic curricula, multimedia technology and the Internet (and all that it implies in the way of communication and access to information) makes the situation very different. So much so that online learning might well be chosen by resident learners.

Today, alternative delivery can embrace the latest in information and communication technology, such as multi-point, interactive video conferencing and multimedia rich Computer-Based Learning. These tools can be used to deliver instruction either at a distance or locally to achieve one of its main objectives--self-directed, time and place independent learning.

Approaches to alternative delivery can be many and varied. At one end of the spectrum it might simply imply the delivery of self-contained units of instruction or Computer Assisted Instruction software, either by traditional or electronic means (e-mail or Internet). At the other end of the spectrum of sophistication, alternative delivery might entail the simultaneous instruction of several groups of learners using computer-managed, interactive video technologies. In the regular school systems, the impact of alternative delivery could be significant; at the post secondary level its impact will be dramatic.

SOME EXPERIENCE-BASED OBSERVATIONS ON WEB-BASED LEARNING

While the term alternative delivery encompasses a variety of approaches, the one which is becoming most prevalent is Web-based learning (Khan, 2000). This section offers some observations based on first hand experience with Web-based learning. The course from which these observations have been derived focuses on the use of technology tools for teaching and learning. Such a course provides a stringent test of what is involved with Web-based learning.

Developing a Web site

The first challenge is to build a viable, resource rich Web site, one that is clearly articulated and easily navigable. Some of the practical aspects associated with the design of a Web site are listed below (Alberta Learning, 1999):

Define who owns the site and who can maintain it

Involve stakeholders in the development of content

Keep the site current

Start small but plan for expansion (in the meantime, don't post partially constructed pages)

Understand the demographics of your audience(s)

Don't overdo links

Test all links

Repeat design elements

Minimize the overhead associated with multimedia elements

Incorporate principles of equality and respect and preserve individual rights and privacy

With Web-based learning, the Web site is the primary resource. The implication is that the learner can complete the course with minimal interaction with the instructor. Some observers will identify a variation of Web-based learning notably, Web-*mediated* learning. With Web-mediated learning, the Web site is still the key resource but the instructor assumes a more prominent role (than in Web-based learning).

Roles of Instructor and Student

Regardless of the approach, with any form of Web-based delivery, both the role of the student and the instructor change. The instructor must actively and frequently encourage students to use the site--this almost has to be a mission. This is particularly true while Web-based learning is in its infancy because students are not likely to be conditioned to the approach.

Very frequently, in addressing a student question, the instructor's first response will be: *Did you look on the Web site?* There is the very real risk that students will interpret such a response as being either obstructive or an indication that the instructor does not have the answer. One way to ameliorate this general situation is to discuss the approach at the beginning of the course.

An instructor needs to be acutely aware that, because the whole course is available at the outset, students will very quickly be working at different places in the course. This, of course, is one of the key goals of Web-based delivery--self paced (independent) learning.

While the above seems obvious it can still take one by surprise. This effect is particularly apparent in a course whose content is technology because many of the questions posed relate to seemingly small technical details. Those small technical details, however, can confound, since technology tends to treat the user as being one hundred percent wrong unless one is one hundred percent (technically and syntactically) correct. The remedy for this is for the instructor to be prepared in all course content at the outset and/or to become comfortable "looking things up on the fly".

New Forms of Communication

Because of the lack of face-to-face contact there needs to be an effective, alternative means of communication. The most natural mode for this is some form of electronic communication, typically a conferencing system or e-mail. Experience shows that students will ask more questions in a Web-based learning environment. In part this is inherently due to the lack of face-to-face contact but it has also been associated with the anonymity that electronic communication affords.

Web-based learning allows students to access a course from home (or any other location with Internet access) and at their convenience thereby realizing a second major goal of alternative delivery, time and place independent learning. Without a doubt, Web-based delivery leads to greatly increased e-mail contact--this is particularly true if students are offsite. The establishment of conference boards and e-mail lists for class use can reduce the amount of direct e-mail contact.

Delivery Costs

Web-based delivery requires a very heavy up-front investment to develop the Web site. It also implies significant maintenance. The more resource rich the site, the greater the investment in both development and maintenance. These aspects are more pronounced for courses that focus on technology and/or that depend significantly on access to other Internet resources.

ISSUES AND CONCERNS

While alternative delivery is currently a very high profile area it is still in its infancy. As with most innovations before it, there has been a lot more said and demonstrated about its promise than has been delivered. The issues/questions surrounding the use of information and communication technology for alternative delivery--and online learning in particular--are many and varied and thus only a few are listed here.

Curriculum

How will various curricula be made available in electronic form? It is important that curricula be re-engineered to take advantage of the power and potential of information and communication technology Who will do this and what processes will need to be put in place to maintain and update courses? The Internet alone has broken down the barriers as to who can develop curriculum. Those who see advantages in the development and delivery of curriculum are now substantially less constrained. They don't even need to be conventionally trained educators.

The convergence of television and Internet technologies further enhances the prospect of third-party development of curriculum as evidenced by Jones (2000), current head of programs for the British Broadcasting Corporation (BBC) Wales, who states:

> We are now entering a new era for educational resources, and digital technology is critical because it revolutionizes communication. It can transform the dialogue from one-to-many to one-to-one interaction, enabling pupils to engage actively with what's on the screen in front of them.
>
> Is this a role for the BBC? I would say yes, for two reasons – because it should and because it can. The opportunity is there for us to use our depth of production experience to contribute to a new and lively age of learning.
>
> The BBC's educational vision was set out in Greg Dyke's first speech as director general and includes the provision of a digital core curriculum for four to 16 year olds. It is a huge challenge and one which calls for productive alliances with content suppliers, technology companies and educational experts. (p. 5).

If such initiatives are planned for regular schooling, imagine the possibilities for post secondary education. Among the issues here is ownership. In conventional instruction, course content is typically the preserve of the creator, usually the instructor. Booth and Turk (2000) note that an employer could encourage faculty to sign over the rights to a course thereby assuming control of it in perpetuity. Having done so, the employer can hire other staff (likely temporaries) to deliver and revise the course without consulting its creator. The implications here are obvious.

Quality of learning

Undoubtedly one of the most important questions of all--*How will the quality of the learning experience be assured?* Beyond the expectations, the anecdotal, and the short-term indicators, what evidence exists to confirm the quality and the depth of learning that has taken place? Indicators of quality include completion rates, student achievement, and learner satisfaction. Much needed research is under way to address this question.

Staffing

Instructors may need to be specially trained to support online learning. Employment contracts may need to be redefined to reflect what will be a very different instructional role. It may be necessary to screen instructors to determine their suitability for the role. Evidence already suggests that self-paced learning places a very heavy demand on teachers who need to respond to a diversity of student requests (Farber 1998). There is evidence to suggest that teacher burnout is more apparent with online learning. As well, it has been observed that communication with a group of learners is easier face-to-face than electronically. Overall, being a virtual teacher is very demanding.

There is a potentially more sinister side to staffing. Aside from the control-of-content issue referred to previously, the use of alternative delivery is appealing to educational administrators who see this approach as a way of reducing the number of instructors and thus the cost of instruction (Wright & Pasek, 1995). Booth and Turk (2000) essentially note this through their comments:

> We are already seeing online education that divides the faculty member's job into the separate pieces of course creator, deliverer, tutor, and grader. The compartmentalization and casualization of university teaching undermine quality and renders obsolete the existence of a secure, professional faculty, with its accompanying guarantees of academic freedom and intellectual integrity. (p. 4).

Administration

Today, many online learning experiences are centered on the establishment and use of a Web site. Concerns here include: 1) who will develop, maintain, and update the site? 2) what are the legal implications of electronic publishing? and 3) who will assume responsibility/stewardship of the Web site--will other instructors know how to use/update the site or will their be a dependency on one individual?

From a practical point of view, how dependent will an institution become on the site both from the technical and staffing perspectives? What are the contingency plans if the site goes down?

Cost

Everything comes with a cost. There is the obvious initial cost of hardware and software. Less obvious costs include: 1) "evergreening" of hardware; 2) upgrading of software; 3) telecommunications; 4) development and maintenance of electronic curricula; 5) delivery systems; 6) technical support; and 7) staff training and development. The term used to embrace all of these elements is total cost of ownership. It is probably accurate to say that using technology in education has increased the cost of the endeavor. As observed by Mcabe (1996), if all we do is splice technology onto existing ways of doing things, we will not be able to afford to use technology in education.

SUPPORTING THE USE OF INFORMATION AND COMMUNICATION TECHNOLOGY

By far the most significant developments in the recent decade have occurred in the networking and telecommunications areas. Deceptively small computers that are networked to the rest of the world now sit on individual users' desktops.

Distributed computing has truly arrived. The good news is that such an environment offers the prospect of standards, effective data resource management and unparalleled access to information. Perhaps the not-so-good news is that, in becoming more sophisticated, the computing environment has once again become complex. This has resulted in the creation of a need for distributed support which amounts to a small army of data processing professionals (especially network specialists and desktop support people).

Technical support is not the only support required. There is also a need to provide staff development and support for instructors who are not only expected to employ technology in their teaching but to promote the technological literacy of their students. As well, in a technological age, there is an increased need to respect rights associated with freedom of information and protection of privacy.

CONCLUSIONS

The proliferation of alternative delivery and online learning has different implications for regular schooling than it does for post-secondary education. In regular schooling, it would seem that the approach would be less acceptable at the lower grade levels than at the higher levels. At the post- secondary level, where learners are more likely to be independent and self motivated, the prognosis is quite different. Some observers (Noam, 1995) go so far as to predict that electronic learning will not only become prevalent but will lead to universities and colleges losing their exclusivity in the delivery of post-secondary education.

Teachers' fears that the computer might either replace them or de-skill their profession seem to prevail (World Confederation of Organizations of the Teaching Profession, 1987). This notion is supported by observations such as "in their bones educators know that technology will replace people. It always has and it always will. About this matter, educators' hunches and fears are justified" (Doyle 1992, p. 515).

Advocates of the use of information and communication technology for alternative delivery have suggested that its use will free the instructor to do what they do best and that the role of the instructor will change from dispenser of knowledge to coach, facilitator, and mentor--well worn clichés. Only time will tell if this prediction turns out to be true in general. Early indicators are that technology is being used to reduce face-to-face contact between the learner and the instructor but that this has not necessarily led to increased efficiency or staff satisfaction (except perhaps for the techno-centric).

With most universities and colleges being able to offer online delivery of courses and programs, competition for students (and the funding and fees that follows them) will evoke significant questions. Increasingly, one might expect to see more institutions incorporating competitors' course offerings within their programs. Accreditation of both courses and programs thus becomes an issue. This is an interesting situation given that the number of prospective students is finite.

To capitalize on the promise of information and communication technology, educational paradigms will need to change. An interesting question arises in this regard, however. Will the academic world witness the emergence of superstar teachers/professors who will, being acutely aware of the fact that they are reaching very large audiences, seek to negotiate lucrative contracts much like their counterparts in the sports and entertainment industries? If so, between the cost of technology and staffing, the economic advantage might not be as significant as perceived. As well, could it be that much further in the future faculty will witness the emergence of post-secondary institutions whose claim to fame will be "a non-virtual university with non-virtual professors"?

REFERENCES

Alberta Learning. (1999). *Web site development--best practices for Alberta school jurisdictions.* Edmonton, Alberta, Canada: Author.

Booth, T., & Turk, J. L. (2000). Ownership rights - the sale of online course content. *The CAUT Bulletin, September,* 4.

Doyle, D. P. (1992). The challenge, the opportunity. *Phi Delta Kappan, 73*(7), 512-520.

Farber, C. (1998). *Integrating independent learning and technology.* A presentation to the Virtual School Symposium, Edmonton, Alberta, Canada.

Jones, K. (2000). Creative little numbers, Wales education 2000. *London Times Educational Supplement, July*, 5.

Khan, B. H. (2000). A framework for Web-based learning. *TechTrends*, 44(3), 51.

Mcabe, R. (1996*). The economics of distance learning*. A presentation to the What Works II: National Conference on Postsecondary Education in the 21st Century, National Center on Postsecondary Teaching Learning and Assessment, State College, PA.

Noam, E. M. (1995). Electronics and the dim future of the university. *Science, 270*, 247-249.

World Confederation of Organizations of the Teaching Profession. (1987). *New technologies and the training of teachers*. Strasbourg, France: Author, Council for Cultural Cooperation.

Wright, P. W., & Pasek, V L. (1995). Use of a computer assisted interactive videodisc approach in the teaching of linear motion in physics. *Proceedings of the International Conference on Computer Based Learning in Science, Opava, Czech Republic*, 499-509.

Wright, P. W., & Pasek, V. L. (1997). An application of multimedia in the physics classroom--the multi-year experience. *Proceedings of the International Conference on Computer Based Learning in Science, University of South Bohemia, Ceske Budejovice, Czech Republic*, F2.

CONTRIBUTORS

John Barnett
Assistant Professor
Science and Technology Education
The University of Auckland
Auckland, New Zealand
E-mail: j.barnett@auckland.ac.nz

Siân Bayne
Researcher, Media and Communication
Queen Margaret University College
Corstorphine Campus, Clerwood Terrace
Edinburgh, Scotland EH12 TS
Tel: (44) 131-662-0178
Fax: (44) 131-316-4165
Email: sbayne@qmuc.ac.uk

A. Faye Borthick
Professor, School of Accountancy
Georgia State University
P. O. Box 4050
Atlanta, Georgia 30302-4050
Tel: 404-651-4472
Fax: 404-651-1033
E-mail: borthick@gsu.edu

W. Dean Care
Academic Assistant to the Dean
Faculty of Nursing
University of Manitoba
395 Helen Glass Centre for Nursing
Winnipeg, Manitoba R3T 2N2
Canada
Tel: 204-474-9958
Fax: 204-474-7682
E-mail: Dean_Care@umanitoba.ca

Karen Casto
Program Developer
Center for Instructional Innovation
Western Washington University
Mail Stop 9094
Bellingham, Washington 98226
Tel: 360-650-4943
Fax: 360-650-4813
E-mail: Karen.Casto@wwu.edu

Jack A. Chambers
Director, Program Development
for Instructional Technology
Florida Community College at Jacksonville
501 W. State Street, Room 471
Jacksonville, FL 32202
Tel: 904-632-3231
Fax: 904-632-3289
E-mail: jchamber@fccj.org

Maxine S. Cohen
Associate Professor
School of Computer and Information Sciences
Nova Southeastern University
6100 Griffin Road
Davie, Florida 33314
Tel: 954-262-2072
Fax: 954-262-3915
E-mail: cohenm@nova.edu

Nikki Conklin
Team Leader, Learning & Leadership
OSU Extension
The Ohio State University
2120 Fyffe Road
Columbus, Ohio 43210
Tel: 614-292-8793
Fax: 614-292-5100
E-mail: conklin.1@osu.edu

R. Stephen Dannelly
Assistant Professor, Computer Science
Texas A&M University, Corpus Christi
6300 Ocean Drive
Corpus Christi, Texas 78412
Tel: 361-825-5877
Fax: 361-825-2795
E-mail: dannelly@falcon.tamucc.edu

Michelle R. Dedeo
Department of Mathematics and Statistics
University of North Florida
4567 St. John's Bluff Road South
Jacksonville, Florida 32224
Tel: 904-620-1047
Fax: 904-620-2818
E-mail: mdedeo@unf.edu

Timothy J. Ellis
Assistant Professor
School of Computer and Information Sciences
Nova Southeastern University
6100 Griffin Road
Davie, Florida 33314
Tel: 954-262-2029
Fax: 954-262-3915
E-mail: ellist@nova.edu

Warren Flood
Graduate Assistant
OSU Extension
The Ohio State University
2120 Fyffe Road
Columbus, Ohio 43210
Tel: 614-292-1944
Fax: 614-292-5100
E-mail: rflood.@magnus.acs.ohio.state.edu

Michelle R. Howard-Vital
Vice Chancellor
Public Service and Extended Education
The University of North Carolina at Wilmington
601 S College Rd
Wilmington, North Carolina 28403-3297
Tel: 910-962-4138
Fax: 910-962-7249
E-mail: vitalm@uncwil.edu

Zhonghong Jiang
Associate Professor
Subject Specializations
Florida International University
11200 SW 8th Street
ZEB 344B, College of Education
Miami, Florida 33199
Tel: 305-348-3790
Fax: 305-348-2047
E-mail: jiangz@fiu.edu

William J. Joel
Associate Professor
Mathematics And Computer Science
Western Connecticut State University
181 White St
Danbury, Connecticut 06810
Tel: 203-837-9353
Fax: 203-837-8339
E-mail: joelw@wcsu.edu

Jo Jones
Associate Professor
Human and Community Resource Development
The Ohio State University
2120 Fyffe Road
Columbus, Ohio 43210
Tel: 614-292-1084
Fax: 614-292-5100
E-mail: jones.20@osu.edu

Kathleen King
Associate Professor, English & Philosophy
Idaho State University
Campus Box 8056
Pocatello, Idaho 83209-8056
Tel: 208-236-2470/208-232-6411
Fax: 208-234-2512
E-mail: kingkath@isu.edu

Linda Kutilek
Leader, New Personnel Development
OSU Extension
The Ohio State University
2120 Fyffe Road
Columbus, Ohio 43210
Tel: 614-292-2968
Fax: 614-292-5100
E-mail: kutilek.1@osu.edu

Ray Land
Director
Teaching Learning Assistance Centre
The University Of Edinburgh
Moray House
Edinburgh, Scotland EH8 8AQ
Tel: (44) 131-651-6668
Fax: (44) 131-316-4165
E-mail: ray.land@ed.ac.uk

Peter Martin
Adjunct Faculty, Physics
Virginia Commonwealth University
1020 W Main Street
Richmond, Virginia 23284-9039
Tel: 804-828-7078
Fax: 804-828-7073
E-mail: pmartin@saturn.vcu.edu

Phillip McClean
Professor, Plant Sciences
North Dakota State University
Loftsgard Hall
Fargo, ND 58105
Tel: 701-231-8443
Fax: 701-231-8474
E-mail: mcclean@plains.nodak.edu

Edwin McClintock
Professor, Subject Specializations
Florida International University
11200 SW 8th Street
ZEB 343A, College of Education
Miami, Florida 33199
Tel: 305-348-2087
Fax: 305-348-2047
E-mail: mcclinto@fiu.edu

Holly J. Morris
Professor, Biology
Lehigh Carbon Community College
4525 Education Park Dr
Schnecksville, Pennsylvania 18078
Tel: 610-799-1753
Fax: 610-799-1527
E-mail: morris42@earthlink.net

V. Adam Niculescu
Associate Professor, Physics
Virginia Commonwealth University
1020 W Main Street
Richmond, Virginia 23284-9039
Tel: 804-828-7077
Fax: 804-828-7073
E-mail: vnicule@saturn.vcu.edu

Joanne E. Nottingham
Director, Office of Campus Diversity
The University of North Carolina at Wilmington
601 S College Rd
Wilmington, North Carolina 28403-3297
Tel: 910-962-3832
Fax: 910-962-3935
E-mail: nottinghamj@uncwil.edu

Julie A. Richardson
Senior Lecturer, Medical and Dental Education
Guy's, King's and St. Thomas' School of Medicine
3rd Floor Weston Education Centre
Cutcombe Road
London, England SE5 9RJ
Tel: (44) 207-848-5718
Fax: (44) 207-848-5675
E-mail: julie.Richardson@kcl.ac.uk

Bernhardt Saini-Eidukat
Assistant Professor, Geosciences
North Dakota State University
Stevens Hall
Fargo, ND 58105
Tel: 701-231-8785
Fax: 701-231-7149
E-mail: bernhardt_saini-eidukat@ndsu.nodak.edu

Donald P. Schwert
Professor/Director Center Science, Geology
North Dakota State University
Stevens Hall
Fargo, ND 58105
Tel: 701-231-7496
Fax: 701-231-7149
E-mail: Donald_Schwert@ndsu.nodak.edu

Brian M. Slator
Associate Professor, Computer Science
North Dakota State University
Iacc Building #258
Fargo, ND 58105
Tel: 701-231-6124
Fax: 701-231-8255
E-mail: slator@badlands.nodak.edu

Larry Spears
Associate Professor, Life Sciences
John A Logan College
700 Logan College Road
Carterville, Illinois 62959
Tel: 618-985-3741 x. 8547
Fax: 618-985-4654
E-mail: larry.spears@jal.cc.il.us

Carl W. Steidley
Professor and Chair
Computing and Mathematical Sciences
Texas A&M University, Corpus Christi
6300 Ocean Drive
Corpus Christi, Texas 78412
Tel: 361-825-2479
Fax: 361-825-2795
E-mail: steidley@falcon.tamucc.edu

Anthony E. Turner
Senior Lecturer, Teacher Education
Canterbury Christ Church University College
North Holmes Road
Canterbury, Kent CT1 1QU
United Kingdom
Tel: (44) 1227-782-880
Fax: (44) 1227-857-61
E-mail: a.e.turner@cant.ac.uk

Katherine Watson
Professor/Department Chair
International Languages
Coastline Community College
11460 Warner Ave
Fountain Valley, California 92708
Tel: 714-505-4699
Fax: 714-241-6287
E-mail: bizarrerie@aol.com

Alan White
Dean, Botany
North Dakota State University
Stevens Hall
Fargo, ND 58105
Tel: 701-231-8380
Fax: 701-231-7149
E-mail: Alan_White@ndsu.nodak.edu

Peter W. Wright
Professor, Educational Psychology
Faculty of Education
University of Alberta
Edmonton, Alberta T6G 2G5
Canada
Tel: 780-492-5363
Fax: 780-492-1318
E-mail: peter.wright@ualberta.ca

Center for the Advancement
of Teaching and Learning
Florida Community College at Jacksonville
501 W. State St.
Jacksonville, Florida 32202

217